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July, 1970

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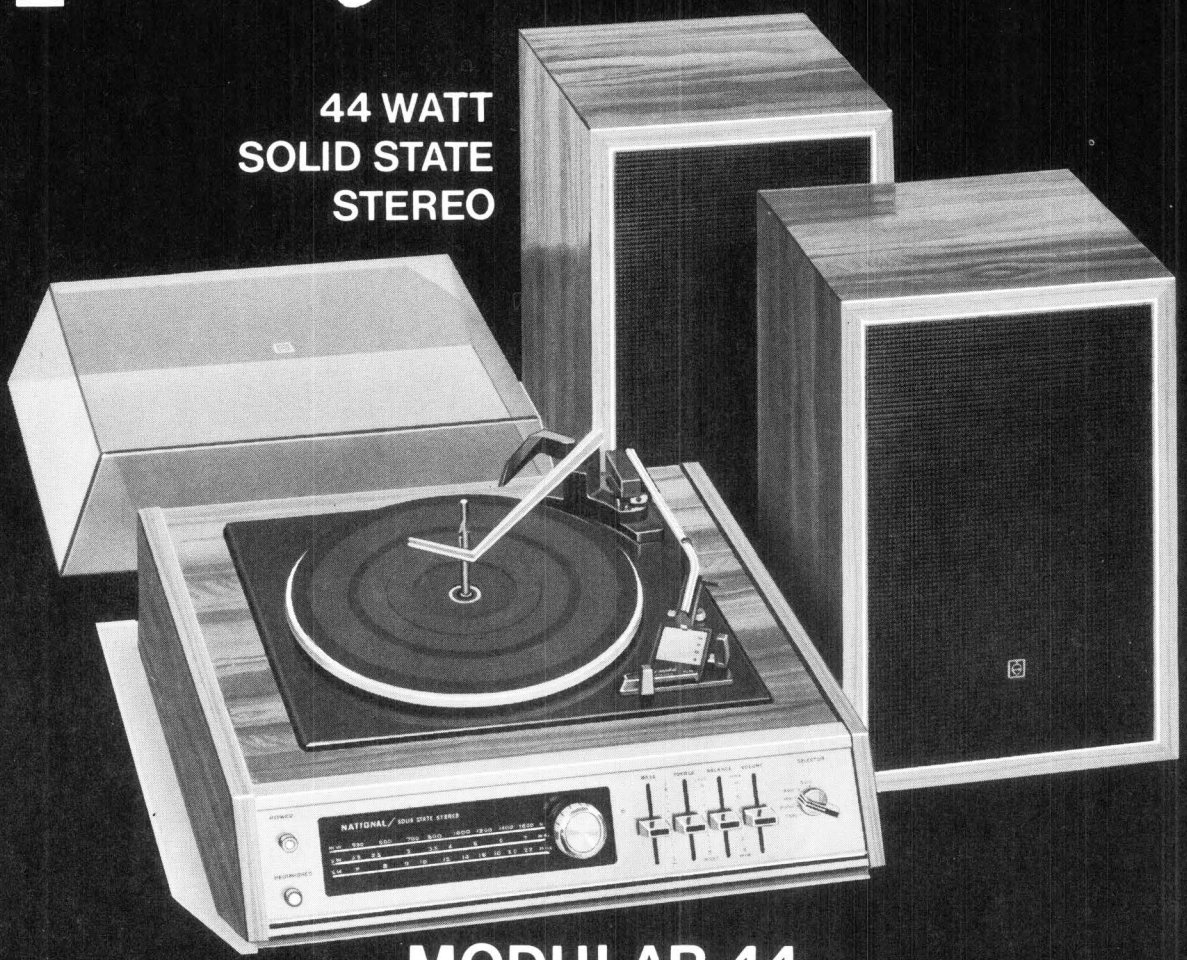

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ELECTRONIC ORGAN PIPES: See page 109 for our reactions to the Conn electronic organ pipe system.

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Phone 2 0944.

Postal Address:
Box 2728, G.P.O., Sydney, 2001, Australia.

Advertising:
Manager, Howard Jenkins.
Sydney Representative, Bill Summons, Office: 8th Floor, 235-243 Jones Street, Broadway, Sydney. Phone 2 0944.
Melbourne Representative, Clarrie Levy, Office: 392 Little Collins Street, Melbourne, 3000. Phone 67 8131.

Circulation:
Alan Parker, Manager, Office: 9th Floor, 235-243 Jones Street, Broadway, Sydney. Phone 2 0944.

Subscription Rates: See back page.

Representation:
Melbourne—John Fairfax and Sons Ltd., 392 Little Collins Street, 3000. Phone 67 8131.
Brisbane—Sungravure Pty. Ltd., 78 Elizabeth Street, 4000. Phone 2 6688.
Adelaide—John Fairfax and Sons Ltd., 104 Currie Street, 5000. Phone 51 3502.
Perth—Sungravure Pty. Ltd., 454 Murray Street, 6000. Phone 21 8217.
Newcastle, N.S.W.—Associated Newspapers Ltd., 22 Bolton Street, 2300. Phone 2 3696.
London—John Fairfax and Sons (Aust.) Ltd., Reuter Building, 85 Fleet Street.
New York—The Sydney Morning Herald Ltd., 1501 Broadway, New York, N.Y. 10036.

Distribution:
Distributed in N.S.W. by Sungravure Pty. Ltd., Jones Street, Broadway, Sydney, N.S.W.; in Victoria by Sungravure Pty. Ltd., 392 Little Collins Street, Melbourne; in South Australia by Sungravure Pty. Ltd., 104 Currie Street, Adelaide; in Western Australia by Western Press; in Queensland by Gordon and Gotch (A'sia) Ltd.; in New Zealand by Truth (N.Z.) Ltd.; in Tasmania by Davies Bros. Ltd., "Mercury," Hobart.

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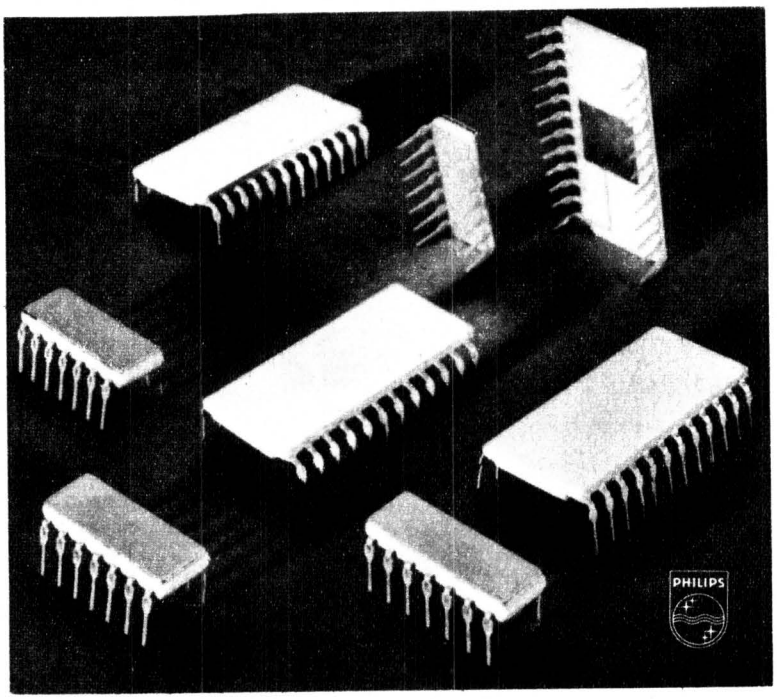

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EDITORIAL VIEWPOINT

by Neville Williams

Use them or lose them!

"The amateurs are not in a very strong position, you know."
They would be very wise to do two things:
(a) use their bands and
(b) avoid fooling around when they do!"

These words are not my own but they were expressed to me in circumstances which indicated that the authorities are well aware that amateurs are making very little use of some of the bands allocated to them. There is therefore no need to be apprehensive about drawing attention to the situation as, in fact, others have already done in amateur journals.

Here's another pertinent observation from a similar source:

"The amateurs are failing to occupy some very valuable pieces of electronic real estate."

I can't speak at first hand for other centres but the truth of such observations can be tested any evening in the Sydney area on the 52 and 144MHz bands—six whole Megahertz in the otherwise densely populated VHF spectrum. During several weeks' after-dinner listening on non-network frequencies, I have not heard a single "CQ" on 52MHz and only the odd one or two on 144MHz. I have called CQ many times on 52MHz without once receiving an acknowledgement. For hours on end, those vital six Megahertz remain silent and unused, their potential occupants otherwise engaged.

By contrast, there is a reasonable amount of activity on the network frequencies and I have no intention of criticising those who, for one reason or another, have opted for this mode of operation. But there is an unfortunate backlash from such activity. The concentration of traffic on three or four distinct frequencies might all too easily be construed in high places to mean that the amateurs have no use for the VHF bands, as such; that all they need is a few channels!

If amateurs are to retain the right to bands of frequencies, they will have to make a determined effort to establish that right by occupancy.

One suggestion, which is not new, is to use the network frequencies when not mobile, as calling channels only, changing to another frequency and possibly to another mode once contact has been established.

Another is to endeavour, if possible, to go on the air each evening, for even a short period, and possibly at a common time for each district. To decrease the risk of calls being missed, there may be an argument for stations coming up on non-occupied, non-network frequencies to run a few minutes of tone or tape as an indication that they will shortly be looking for a contact.

A still further possibility, with modern components, is an elementary slow-scan adaptor for VHF converters, sufficient to alert the listener, by even as much as a "plop," that another signal has come up on the band.

The W.I.A. or individual amateurs may be able to bring forward other suggestions aimed at increasing traffic on the bands generally, as distinct from the network frequencies. Rest assured that the heading on this editorial is not a catch phrase. It summarises what is a very real and a very urgent problem for the amateur fraternity.

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THE
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On the cover

The letters DSVR on the side of this Lockheed-built craft stand for Deep Submergence Rescue Vehicle. Inside the torpedo-shaped outer shell is the main pressure hull composed of three interconnected spheres. Designed to be transported anywhere in the world inside 24 hours, it can operate safely at 5,000ft where the pressure is 2,225lb per sq. inch. DSVR1 was constructed for the U.S. Navy. (See story elsewhere.)

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NOTE
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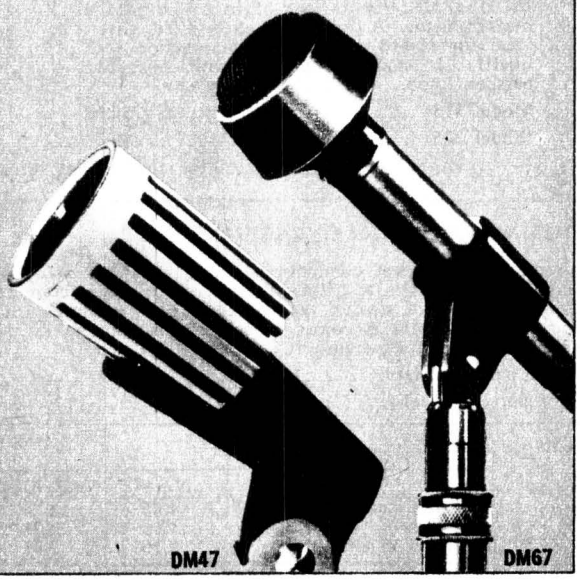
DM47: Highly efficient, cardioid, uni-directional dynamic microphone with excellent characteristics especially designed for all stage and recording use. Impedances 50K or 600Ω or 50Ω; Output Level: –73db; Response: 40 CPS – 18 KCS; Cardioid (uni-directional); Dimensions: 5½" x 1 13/16"; Weight: 18 ozs (incl. lead); Case. Black zinc diecast with chrome facings with on/off slide switch 20 ft lead; List Price: $36.00.

DM67: Superb quality, cardioid uni-directional dynamic microphone, stable performance designed for stage and recordings. Impedances: 50K or 600Ω or 50Ω; Output Level: –73db; Response: 40 CPS – 18 KCS; Cardioid (uni-directional); Dimensions: 5⅛" x 1⅛"; Weight: 7¼ ozs; Case: Precision moulded, aluminite zinc diecast, with satin chrome facings. Fly-off cradle, 20 ft lead, on/off switch. List Price: $33.00.

DM78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GE:P548

read what the experts have to say about the GOLDRING LENCO GL75

PERCY WILSON

Manufactured by Goldring Manufacturing Company (GB) Ltd., 486-488 High Road, Leytonstone, London E11. Manufacturer's specifications: TURNTABLE: AC mains: 200/240 V. 50Hz. Mains switch fully click suppressed 4-pole constant velocity motor (15 VA). Continuously variable speed adjustment. Adjustable stops for 16, 331/3, 45 and 78 rpm. 9 lb. non-magnetic dynamically balanced turntable. Wow and flutter measured, according to DIN spec., 0.06%. Rumble measured, according to DIN spec., -60db. Speed variations + 0.2% for 10% mains voltage change. Automatic disengagement of idler wheel. Dimensions: front to back: 13in. Side to side: 15 in.
TRANSCRIPTION ARM: Pickup arm with counter-balance weight and bias compensatibn (anti-skating) adjustment. Knife-edge bearings. Stylus pressure adjustable from 0.5 to 5 grams., with sliding weight. Minimum stylus pressure 0.5 gram. Removable lightweight pickup headshell. Total length of pickup arm: 12.4 in. Tracking length (distance from pedestal to centre of turntable) 8.3 in. Overhang of stylus 0.675 in. Total adjustment for stylus position: ½ in. Offset angle: 23° 12'. Tracking error + 0.8°. Can accommodate any cartridge. Hydraulic lowering device.

I have now had one of these transcription units on test for over six months; and some of my professional colleagues have made independent assessments which agree with mine. So, let me not beat about the bush, but declare my verdict straight away. This is, quite simply, that the GL.75 is easily the best integrated turntable and arm unit that the partnership betwee Goldring have yet produced.
This is, of course, a mouthful, fo ship's products have long been kn in the front rank. I have no hesita in declaring that the GL.75 i reckoned with in any company cumstances, anywhere in the w Having made that confession o not merely of faith, I must justify it by stating the resu tests. In this I shall not ju cription that can be glea ifications. I shall only comm the performance.
First of all, I must refer features. This is the tinuous variation of tur icians and others who perfect pitch, this is other turntable I know It is secured by havir wheel which travels turntable. This idle izontal axis and its times thought that not affect the mo hasty and wrong of design in which angles to the turnta than a design in whi to the turntable.

In my tests I mounted the motor plate on stilts, as it were, above a rather thin motor board, which would resonate quite easily. I found the possibility of rumble all right, but I also found that the makers' recommendations had indicated the answer. In the first place, the motor plate must be mounted, as specified, on a motor board at least ¾ inch thick. Do not on any account go below ¾ inch. If the motor board in your cabinet is slimmer than this, then stick a sheet of Celotex to it so as to damp out any natural resonance.
When suitable precautions are taken in mounting; such as the makers specify, the possibility of rumble is avoided. I have enlarged in this report on this possibility, because of the special vulnerability in a vertical drive as compared with a horizontal one; and to make it clear that the makers have safeguarded the position in their mounting instructions.

The second precaution to be taken, and this is vital, is that the motor should always be switched off and on at the switch on the motor plate and never at an independent switch. Otherwise the idler driving wheel would be left in contact with the turntable, and a tiny flat may be created on the rubber driving rim. In order to have accurate control of the turntable speed this rim has to

Hi-Fi News', February, 1969. Frank Jones

MANUFACTURER'S SPECIFICATION.
Precision engineered transcription motor and arm. **Turntable:** Die-cast non-magnetic alloy dynamically balanced. **Diameter:** 12¼ in. **Weight** 8-8 lb. **Speeds:** Infinitely variable between 30 and 86 r.p.m.; click-in stops for standard speeds including 16⅔ r.p.m. **Wow and flutter:** 0-06% (DIN specification). **Rumble:** —60 dB. **Speed stability:** Within 0-2% for a 10% change in mains voltage; within 0-3% for pickup playing at 6 gm. **Lowering device:** hydraulic.
PICKUP ARM. Lightweight type with decoupled counterweight and separate playing weight counterbalance. **Stylus pressure:** Infinitely variable between 0–5 gm, calibrated at ¼ gm intervals. **Total length:** 12-4 in. **Effective length:** 8-3 in. **Overhang:** 0-675 in, adjustable up to ¼ in. at the headshell. **Offset angle:** 23° 12'. **Tracking error:** ±0-8°. **Height:** Adjustable.
Dimensions: 15×13×2¼ in. (above baseplate) × 3 in. (below). **Weight:** 18-7 lb.
GL75/P, on plinth with Perspex lid, as in photo.

Manufacturers: Goldring Manufacturing Co. Ltd., 486-488 High Road, London E.11

DESPITE its up-to-the-minute appearance ng Lenco *GL75* is the latest in a tables and playing desks from hich started, as far as I can he *GL56*—the first turntable d in *Hi-Fi News* and basically this machine. Since then we with an improved pickup sible layout (the *GL56* had ly under the pickup in its r some strange reason), st massive turntable in with another, improved, and now the *GL75* with ter styling and a fine go with it.
re of all these units is and the unique drive it. It has been pages, but many with the layout requirements, so oints will do no

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BROADCASTING

These two men really laid the basis for all future work. In 1897 Marconi was demonstrating his wireless telegraphy system from the roof of London Post Office and soon was broadcasting up to nine miles, from various points in England.

Marconi was called back to Italy by the Italian Government in June, 1897, and he set up a radio station at Spezia, in the Gulf of Genoa, from where he was soon able to contact warships up to 12 miles away.

In July, 1897, the Marconi patents were acquired in Britain by the Wireless Telegraph and Signal Company Ltd. (later to become Marconi's Wireless Telegraph Company) who began to develop them commercially.

But Marconi himself pressed on with his investigations. In 1898 he established communication across the Channel between England and France; in 1901 he established radio contact across the Atlantic, between Cornwall and Newfoundland.

Marconi's trans-Atlantic transmissions laid the basis of world-wide wireless communications, and led to considerable expansion of the commercial activities of the Marconi company.

Of course the development of wireless telegraphy, as it still was, was not confined to Europe. Australia, among many other countries, realised its importance although the early experiments were conducted by amateurs. In 1905 Australia's Wireless Telegraphy Act officially recognised communication by wireless, which was then confined to ships' navigators and some amateurs ashore.

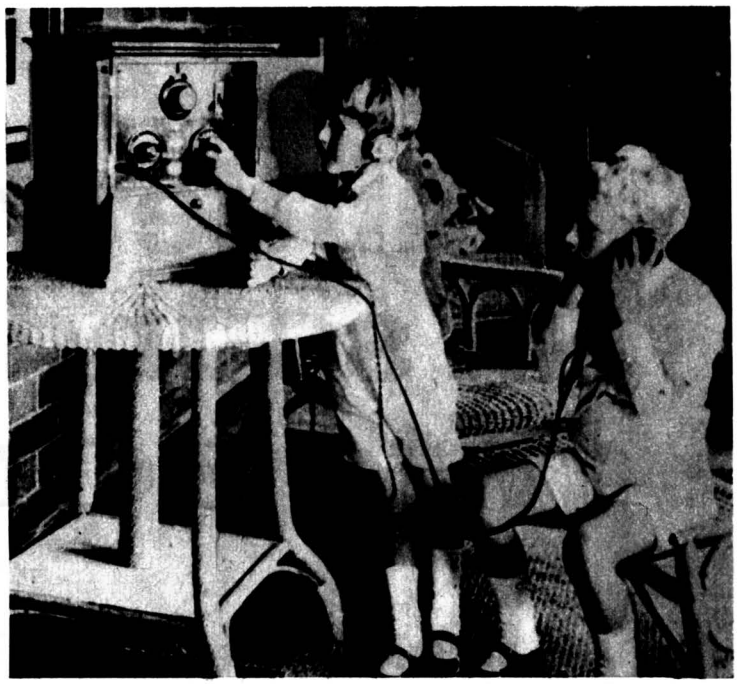
Marconi continued with his own experiments, but when interviewed for a London magazine he said he did not foresee wireless broadcasting as a medium of home entertainment: "Who would want to sit at home listening to lots of dots and dashes," he is reported to have said. From which it appears that the owner of the foremost name in the development of broadcasting did not at that time find radio telephony a practical proposition.

However, the first big step which was eventually to lead to sound broadcasting had already been taken. In 1904, after a long series of experiments, the electrical adviser of Marconi's Wireless Telegraph Company, John Ambrose Fleming, applied for a patent for his thermionic valve, the first device to make use of electron flow between separated electrodes, and the first really practical detector. However, Fleming's valve was only a diode. As such, it could only rectify, not amplify.

In the U.S.A., Lee De Forest was working on the development of a practical radio telephony system. In 1906, he hit on the idea of inserting a third electrode between the negative electrode (cathode) and the positive electrode (anode) of Fleming's detector. This third element, which he called the grid, made the valve a much more sensitive device, since a small signal applied to the grid could be reproduced greatly amplified at the anode.

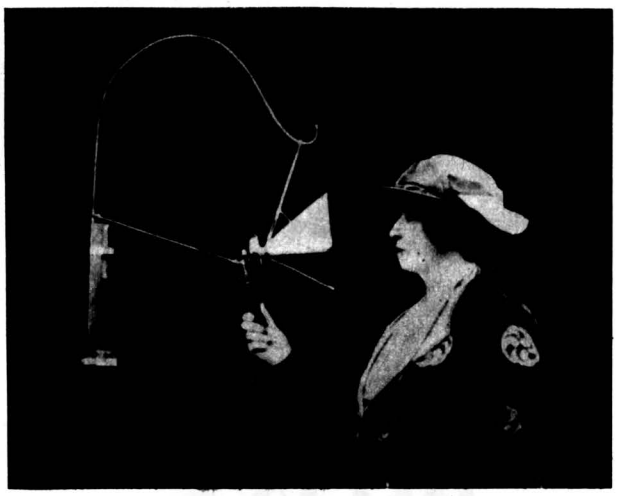
Thus was invented the triode valve, and it is from this single invention that the whole science of radio telephony has developed. Not only was De Forest's "Audion" as he called it capable of amplifying weak radio signals, but it could also be used as an oscillator to provide the continuous radio frequencies necessary as carrier waves; and it allowed modulation of the carrier by the audio frequencies. Thus, by the one invention, all the difficulties which had been holding up the development of radio telephony were overcome. Later, De Forest established a claim in the High Court of the U.S.A. as the inventor of the regenerative circuit, using positive feedback, another important development in broadcasting.

The first recorded account of a wireless broadcast occurred on Christmas Eve, 1906, when another American radio pioneer, R. A. Fessenden, transmitted both speech and music from an experimental station at Brant Rock, Massachusetts. The program, consisting of a poem, gramophone records, and a talk, was heard by radio operators on ships up to several hundred miles away. The frequency used was 50KHz. Fessenden used a water-cooled microphone, as in those days the carrier current actually flowed through the microphone circuit to be modulated. The carrier was generated by an Alexanderson alternator, and the power delivered to the aerial was 1KW. The best that could be said for this system was that it worked after a fashion, but the results were comparable with Baird's early TV experiments. While the listener at the receiving end would be aware that speech was coming in, it was not always possible to hear what was being said.



One of the first commercially built broadcast receivers available in Australia, manufactured by A.W.A. The era is the early 1920s.

Just as television forged ahead when freed from the shackles of mechanical scanning devices, so did broadcasting make rapid progress once electronic means became available for generating radio frequencies, replacing the mechanical alternators. Lee De Forest conducted an experimental broadcast in Paris from the Eiffel Tower in 1908, transmitting a recorded music program. The transmission could be received up to 500 miles away. Two years later he made a live broadcast from New York's Metropolitan Opera House in which the great Caruso sang. On this occasion he used a 500KW transmitter.



Dame Nellie Melba's broadcast from the Marconi works, Chelmsford, on June 15, 1920, was responsible for a tremendous upsurge in interest in broadcasting. The broadcast was heard as far away as Persia. Note the makeshift microphone, constructed from a standard telephone microphone and the wood from a cigar box.

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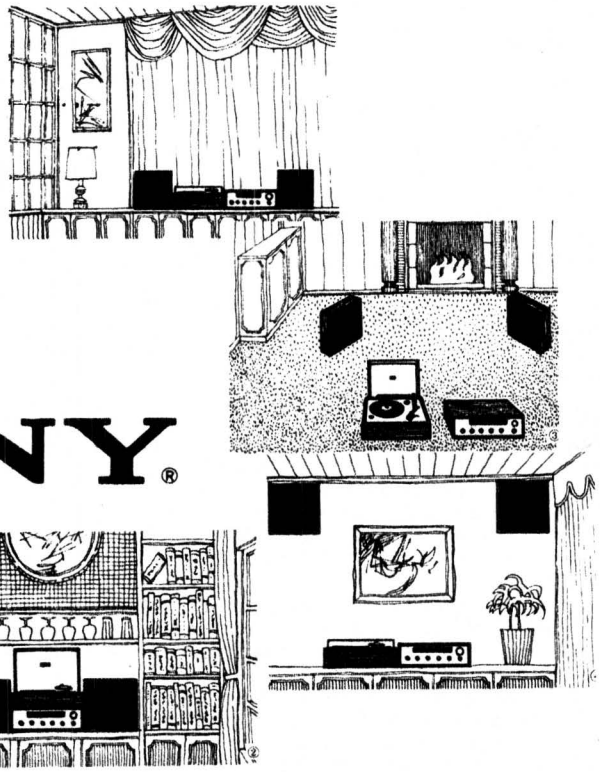

Two superb amplifiers from the SONY range:

TA-1010 Stereo Amplifier

Superior stereo amplifier employing SEPP OTL circuit, with a pure undistorted 30 watts R.M.S. **Specifications: Power output:** Dynamic power output 58 watts both channels. Rated output 15 watts per channel, both channels operating. **Harmonic distortion:** Less than 0.5% at rated output (at 1 kHz). **Intermodulation distortion** (60 Hz: 7 kHz = 4:1): Less than 1% at rated output. **Frequency response:** TUNER, AUX-1, AUX-2, TAPE: 20-60,000 Hz; + OdB; — 3dB; PHONO-1, PHONO-2; RIAA equalization curve ± 1 dB. **Tone controls:** BASS 100 Hz ± 10 dB; TREBLE 10 kHz ± 10 dB. **Filter:** HIGH FILTER 6 dB/oct. above 5 kHz. **Loudness control:** 100 Hz + 8 dB, 10 kHz + 4 dB (Att. —30 dB). **S/N ratio:** PHONO-1, PHONO-2, better than 70 dB, 3 mV TUNER, AUX-1, AUX-2, TAPE, REC/PB; better than 90 dB, 250 mV. **Dimensions:** 16 9/16 (W) x 4 7/8 (H) x 9 11/16 (D). **Weight:** 10 lbs.

SONY Record Player Type PS122 and SONY Speakers SS122 are available as matching components for the STR-122.

STR-122 Amplifier/Tuner

Reliable solid-state amplifier with two superb tuners. **Specifications: AM tuner section**—Tuning range: 530-1,605 kHz. **FM tuner section**—Tuning range: 87-108 MHz. Antenna: Built-in ferrite antenna and external antenna terminal. Terminals provided for FM dipole antenna. **Amplifier section**—Inputs: Sensitivity & impedance: PHONO 23 mV, 100 k ohms. TAPE 300 mV, 40 k ohms. REC/PB 500 mV, 80 ± 20 k ohms. Outputs: SPEAKER OUT: Accepts 8 ohm speakers. HEADPHONE OUT: Accepts all high & low impedance headphones. REC/PB OUT: 40 mV. AC outlet: Unswitched 300 watts. Dimensions: 16 17/32 (W) x 4 13/16 (H) x 12 7/32 (D). Weight: 9 lb. 8 oz.

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Telephony stations operated by amateurs were opening up all over America and the word "radio" began to replace "wireless." In fact much of the early development of broadcasting came from the work of devoted amateurs. They operated small stations, produced their own programs and broadcast them to friends with receivers.

But there were problems in America. There was no law controlling radio broadcasts (there was in England) and soon there was chaos in the airwaves as more and more experimenters built their own transmitters. It became so bad that in 1906 when President Theodore Roosevelt visited the American Fleet off Cape Cod the Newport Naval Station was unable to get a message to him because of amateur interference. Eventually, in 1917, when America became involved in World War I, the Government stopped all amateur radio transmissions.

The picture in England was very different. The Government in 1904 put through the Wireless Telegraphy Act which provided that all transmitters and receivers "of wireless telegraphic signals" had to have a Post Office licence. The Act was so strictly applied that it was difficult to obtain a licence for a receiver, let alone a transmitter. Development was slow, and the first brief transmissions of wireless telephony were not made until the winter of 1913 and 1914. And when the war began the Government banned all private experiments, and even took over the Marconi company.

After the war things really began happening in England. For a start hundreds of young men returned from the war with knowledge of the new art of "communications"; they understood the magic of telephones, Fullerphones, valves, wireless, "waves," and microphones. Many built their own sets, experimenting and broadcasting among themselves.

Also, and more important, the major radio manufacturers applied to the Post Office for permission to experiment in both radio telegraphy and telephony. One of the first companies to receive a licence was Marconi's Wireless Telegraph Co.

The company opened a 6KW transmitter at Chelmsford in Essex in 1919 and although it was primarily used for tests of speech, short transmissions of music were also made. A year later, regular half-hour programs were broadcast, mainly to see whether the public was interested in wireless. These were the first regular broadcasts in England, although experimental. The public loved them, even though the programs were sometimes very dull by today's standards. But public interest was really stimulated when on June 15, 1920, Australia's Dame Nellie Melba sang a selection of songs from the Chelmsford studio. The broadcasts were heard as far away as Persia. Dame Nellie described the occasion as the most wonderful moment in her career, and the broadcast caught the public's imagination.

But the rapid development of wireless broadcasting, especially for home entertainment, worried some people. Dame Nellie's broadcast was described by one newspaper as "frivolous use of a national service. These concerts are interfering with important communications."

"Wireless," said the Army, "which is ideally equipped to be the servant of mankind, is being treated as a toy to amuse the children."

While these strictures may seem out of place by modern standards, it should be realised that the fears expressed were not groundless. Radio had already assumed an important role in the communications field, particularly at sea, and the selectivity of receivers at that time was extremely poor. It was feared that broadcasts, even on a limited scale, could severely interfere with legitimate communications traffic.

Suddenly the Post Office banned all broadcasts from Chelmsford, and British broadcasting came to a grinding halt. Amateur enthusiasts couldn't believe it and eventually 63 different amateur radio societies petitioned the Postmaster-General to resume telephonic transmissions.

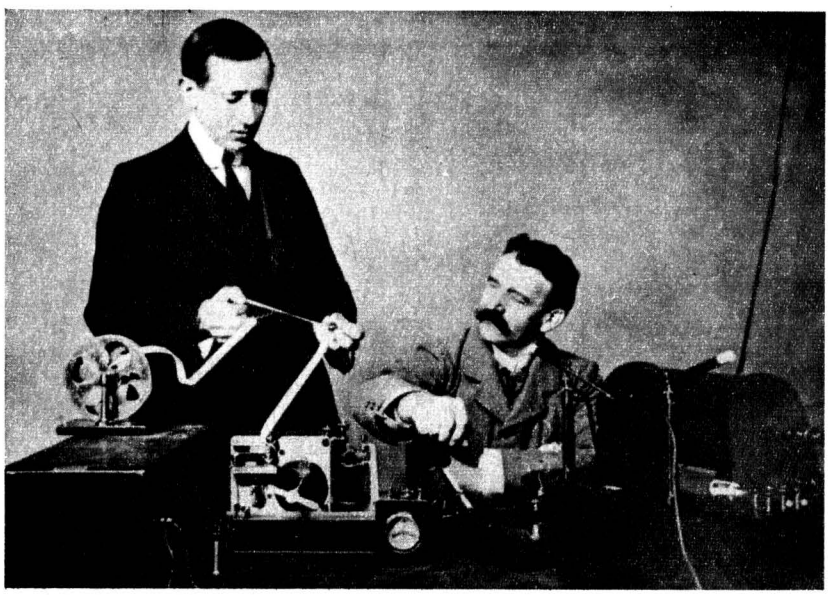
The petition worked, and the Post Office agreed that regular half-hour weekly programs could be broadcast from the Marconi company's station at Writtle, just outside Chelmsford. The first began on February 14, 1922, and consisted of short announcements and long periods of gramophone records. The announcer (he was also a fine radio engineer) was P. P. Eckersley, who later became Chief Engineer for the B.B.C. He soon developed his own style and began talking more and more to his listeners. He was Britain's first DJ and fan mail poured in.

In May, 1922, Marconi opened the famous station 2LO in London and it immediately became the most popular station in Britain with at least 50,000 listeners. But it also became obvious to the Government that as the listening audiences grew the country would be clamouring for regular broadcast programs. The Postmaster-General moved with caution, realising that the problem of allocating frequencies to new stations would be very difficult in such a small country as Britain.

In America, where broadcasting was booming, hundreds of stations were operating on a narrow band of frequencies and this chaotic state was an object lesson of what not to do. So the Postmaster-General decided to grant an exclusive licence to a single broadcasting organisation — on the condition that an adequate service could be guaranteed for a reasonable length of time. Six radio-manufacturing firms formed the British Broadcasting Company, which in 1927 became the British Broadcasting Corporation, under Royal charter. The Marconi company was one of these, and it was Marconi's Station 2LO which was used for the first B.B.C. broadcasts.

The B.B.C. was formed on October 18, 1922, but it did not receive its licence from the Post Office until four months later. However, the first B.B.C. broadcasts went out from 2LO on November 14, 1922, the day of a general election in Britain. The first programs were concerned with election results.

The announcer was Arthur Burrows, the B.B.C.'s first director of programs (and later the first secretary of the International Broadcasting Union). Among the problems he encountered was the heat generated by the football-sized valves used in all stages of the transmitter. He could not turn on a fan to help dissipate this heat, as the noise would have interfered with the transmission. The only way to cool the studio was to open the windows. Unfortunately it was foggy outside, and soon the studio was filled with fog.



Marconi and his assistant George Kemp, with the equipment they used for the first reception of signals across the Atlantic, in 1901.

Programs from the regional studios at Manchester and Birmingham began the following day.

By this time there were some 500 broadcast stations operating in the U.S.A. The newly formed B.B.C. was able to profit from the experience of American broadcasters. One advantage of Britain's monopoly system was that it avoided the scramble for frequencies that occurred in America. On the other hand, the lack of a competitive element did tend to stifle progress for a time. However, the disciplined development which characterised the B.B.C. eventually made it the world's greatest broadcasting organisation.

By October, 1923, the B.B.C. had eight stations operating throughout Britain, and in 1925 it opened a power-

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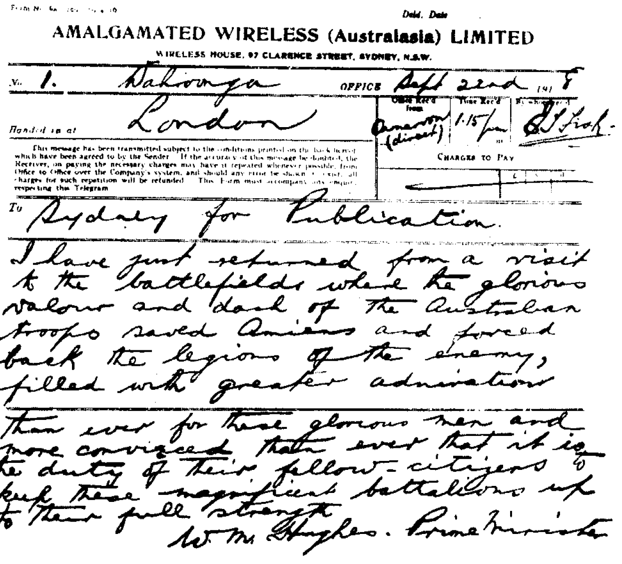
AMALGAMATED WIRELESS (Australasia) LIMITED
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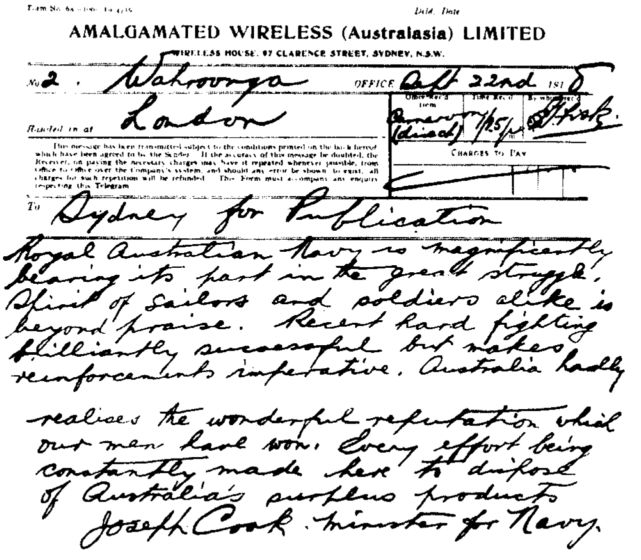
No. 1. Wahroonga OFFICE Sept 22nd 1918
Handed in at London
Carnarvon (direct) 1.15pm

To Sydney for Publication

I have just returned from a visit to the battlefields where the glorious valour and dash of the Australian troops saved Amiens and forced back the legions of the enemy, filled with greater admiration than ever for these glorious men and more convinced than ever that it is the duty of their fellow-citizens to keep these magnificent battalions up to their full strength
W. M. Hughes. Prime Minister


AMALGAMATED WIRELESS (Australasia) LIMITED
WIRELESS HOUSE, 97 CLARENCE STREET, SYDNEY, N.S.W.

No. 2. Wahroonga OFFICE Sept 22nd 1918
Handed in at London
Carnarvon (direct) 1.15pm

To Sydney for Publication

Royal Australian Navy is magnificently bearing its part in the great struggle. Spirit of sailors and soldiers alike is beyond praise. Recent hard fighting brilliantly successful but makes reinforcements imperative. Australia hardly realises the wonderful reputation which our men have won. Every effort being constantly made here to dispose of Australia's surplus products
Joseph Cook. Minister for Navy.

The first direct wireless messages from England to Australia, transmitted from the Marconi Transatlantic Station at Carnarvon, Wales, and received by Mr (later Sir) Ernest Fisk, at his home in Wahroonga, N.S.W., September 22, 1918. The message on the left is from Australia's then Prime Minister W. M. Hughes, and that on the right is from the Minister for the Navy, Joseph Cook.

ful new transmitter at Daventry which brought its programs within reach of 85 per cent of the population. The Daventry station, 5XX, operated in the long-wave band on a then new wavelength of 1500 metres (200KHz) with a power of 30KW. Broadcasts from it could be heard all over Europe and the station became famous in its 10-year existence.

In America the radio boom continued. Broadcasting there was developed by private enterprise with a minimum of Government supervision (except in the granting of licences) and companies soon saw the advantage of advertising on air. Despite some problems the competition among stations did lead to many developments.

With regular programs now available, sales of broadcast receivers began to climb. When the B.B.C began operation, the majority of sets were of the crystal detector type, and many of them were suitable only for headphones. Sets with loudspeakers were mainly simple two- or three-valve battery powered units. At this stage, the technical development of the transmitting side was way ahead of the receivers available to the public. A major weakness was the loudspeaker, which introduced a large amount of distortion into the reproduced sound. It should be remembered that the loudspeakers used the same principle as the telephone earpiece — a metal diaphragm driven by an electromagnet. This was coupled into an elaborate but inefficient horn.

However, improvements were on the way, and progress occurred with came in rapid succession: the development of the moving coil loudspeaker; the pentode valve, which made possible greatly improved stability at the front end; the invention of the superheterodyne principle; the development of mains operated valves. With these innovations, and a reduction in size of components, the domestic receiver soon became a single compact unit with receiver and loudspeaker housed in one attractive cabinet, equipped with single-dial tuning and delivering sound of good quality.

While the design of receivers was steadily improving, the conditions for broadcasters was steadily becoming more chaotic in some countries, particularly America, where the laws relating to broadcasting were quite inadequate for the situation then prevailing. These laws had been framed initially to relate to maritime users and experimenters, and with the radio boom the allocation of frequencies and the granting of licences was in a state of confusion. Fortunately the authorities woke up to the situation before it became hopeless, and an international conference was held in Washington in 1927, at which the various countries participating attempted to lay down regulations which would apply to increasing momentum. The following broadcasting in the countries concerned. Out of this meeting came the forerunner of the International Telecommunication Union (I.T.U.), and the ground work was laid for a system of allocating frequencies.

In 1925 in Europe the International Broadcasing Union (I.B.U.) was formed to control regulations throughout the continent. The Union had a difficult birth because of the conflicting interests of the countries involved, but eventually revised plans for the allocation of medium and low frequencies were agreed upon.

Bitter political problems arose within the Union with the division of Europe after World War II so the B.B.C. organised the formation of a new European Broadcasting Union (E.B.U.) with headquarters in Geneva. Members included all the West European countries and many from the Middle East and Mediterranean region.

At the same time as Europe was sorting out its peculiar difficulties (small countries, different languages, poor reception), America was bringing some order to the chaos through the Federal Radio Commission (F.R.C.), formed by Act of Congress in 1927 (later to become the Federal Communications Commission). Several technical developments helped the F.R.C. in its work. The main advance was FM (frequency modulation) which was commercially developed in the late thirties and which enabled the F.R.C. to grant licences to many more stations.

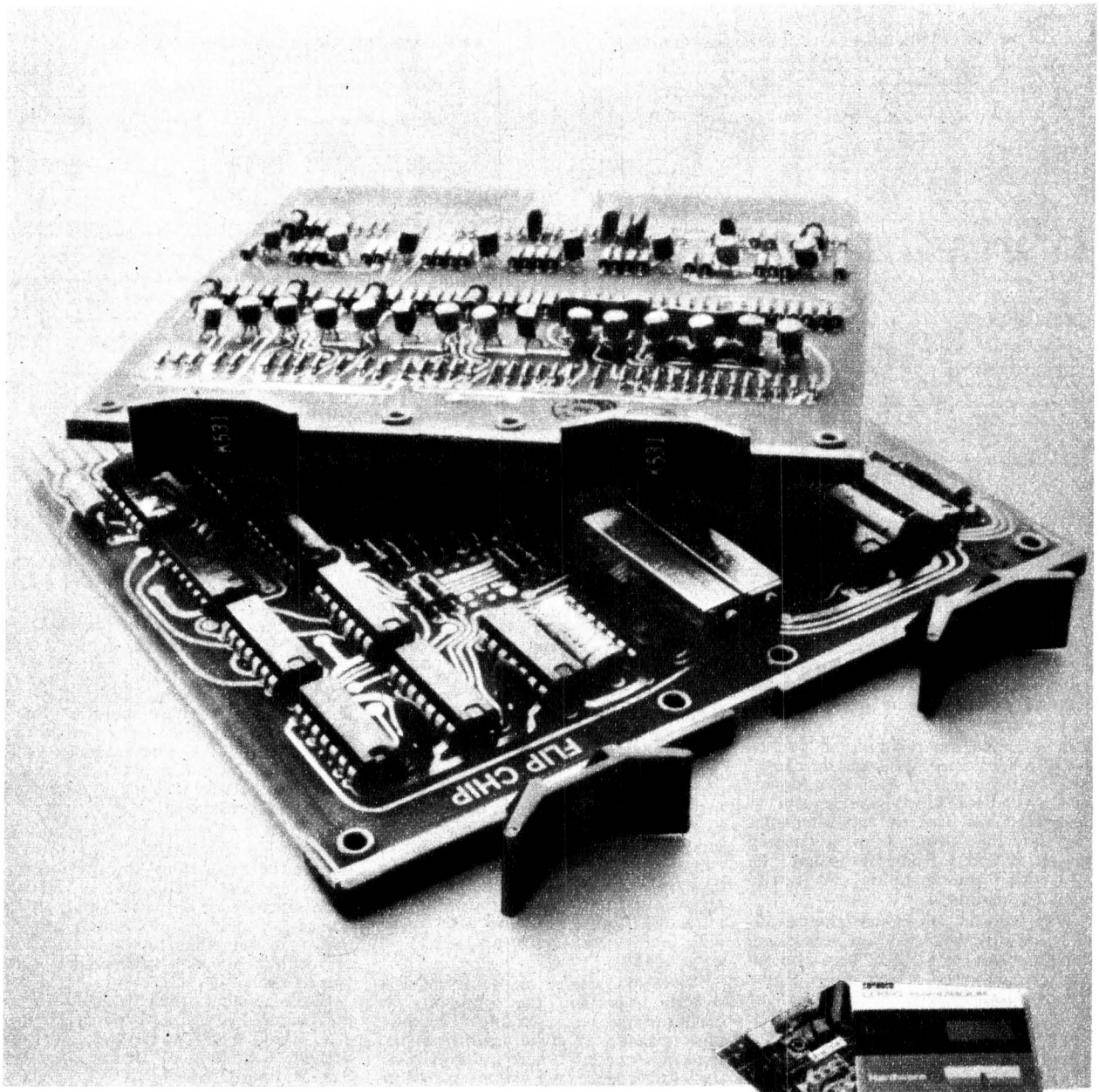
American broadcasting continued to develop by private enterprise and radio advertising became an accepted part of the broadcast scene. Most European countries developed their systems along B.B.C. lines, getting their revenue either from the public through licences, from public funds, or from both.

With the advent of television in the late thirties many people feared the end of radio broadcasting was in sight.

IN 1927: The cost of broadcasting records

This extract from "Wireless Weekly" for January 21, 1927, shows that the commercial stations had their problems then, as now, in the use of copyright recordings.

"Correspondence received by 2FC shows that a small battle is being waged over the broadcasting of gramophone records. A large batch of letters has been received asking why many of the beautiful records regularly broadcast in the daytime programs are not reproduced at night. On the other hand, another group of writers takes the attitude that many of these records should have been dropped out during the day, to be replaced by vocal items. The rendition of records is not a simple matter of money, as many are prone to think. Every record that goes on the air costs the broadcasting station eight shillings for copyright, and as these records occupy but a short time, this builds up a tremendous bill at the close of every day."



The tortoise and the hare.

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West Perth, W.A. 6005.

But rather than decline, it boomed again. Small portable sets were introduced, and international broadcasters installed more powerful short-wave transmitters that brought the world into the living-room. The high-quality FM broadcasting also attracted many listeners.

Slowly, through further international agreements, domestic broadcasting was assigned to two frequencies — low frequencies from 150KHz to 550KHz, and medium frequencies from 550KHz to 1660KHz. Short-wave stations were to use various frequencies from 2,200KHz to 30,000KHz. It soon became clear in many countries (especially Europe) that domestic reception was seldom free from interference because of the congestion of medium and low frequency bands, so came the development of FM services on that portion of the VHF band between 87.5MHz to 100MHz.

Then came the transistor, which has virtually replaced the valve in domestic radio equipment. The first effects of the transistor revolution were a dramatic reduction in size of equipment, and also power consumption, so that it now became feasible to make small portable radios which operate for long periods from small internal batteries. With the introduction of printed wiring boards, it become possible to mass-produce transistorised receivers on an assembly line basis. Assembly line techniques became more streamlined, resulting in the availability of very cheap receivers, so that broadcasting came within the reach of millions of people who previously could not afford to buy receivers. Now there is virtually no villager in remote Africa, Bedouin tent dweller, or Asian peasant, who does not enjoy the advantages of broadcasting.

The discrete transistor is already slowly but surely being superseded by integrated circuits, and these, in conjunction with micro components, have resulted in even tinier receivers. This miniaturisation, spurred on by the development of tiny components for space research, has resulted in such developments as wristwatch radios powered by the heat of the body.

But the biggest benefit of all this development is surely the fact that soon every person in the world will have access to a radio. The United Nations say that only in Asia and Africa are there less than five sets per 100 people —a figure which the U.N. considers "minimum adequacy."

The United Nation's Educational Scientific and Cultural Organisation (UNESCO) would like to see every family in the world with one set — this would mean an additional 400,000,000 sets.

In the meantime most countries are doing fairly well. Latest UNESCO figures show that there is nearly one radio for every person in America — a grand total of 202,000,000 radios.

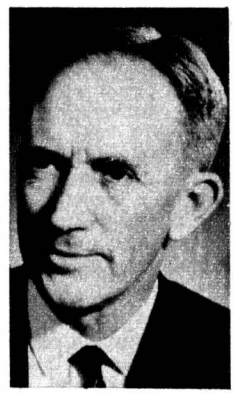
Other figures include:
Australia 2,625,900 sets
Japan 23,000,000 sets.
U.S.S.R. 88,000,000 sets.
Norfolk Island 500 sets.

Radio, as far as the U.N. is concerned, just can't go wrong: "It has a long and active future before it is surpassed in immediacy, range and economy."

And who can disagree with that! ■

SYDNEY VENUE FOR INTERNATIONAL MICROELECTRONICS CONFERENCE

Delegates from more than 10 countries will meet at the University of New South Wales in August for a conference unique in Australia's electrical engineering history.



Prof. R. M. Huey

The International Conference on Microelectronics, Circuits and System Theory will run over four days in which about 70 technical papers will be presented. In addition, there will be dinners, evening programs, tours and hospitality for delegates' wives.

Groundwork for the conference began last year with the formation of a Steering Committee consisting of Professors L. W. Davies and R. W. Newcomb as co-chairmen with Professor R. M. Huey (Local Arrangements) and Dr G. A. Rigby (Technical Program). Since then, working committees involving about 30 people have been formed to handle the variety of tasks to make the conference run smoothly.

The formal opening of the conference, on the evening of Tuesday, August 18, is open to the public. The dinner beforehand is planned as a "shoulder-rubbing" occasion. The evening's speeches feature Sir Hugh Ennor, Secretary of the Department of Education and Science as the Guest-of-Honour, followed by the Conference Keynoter, Professor John Linvill, of Stanford University, who is well known for his pioneering work in the development of an electronic blind reading aid. His topic is "Harnessing new technology to society's needs through the government-university-industry system."

At most of the 14 technical sessions, scientists and engineers who are eminent in their areas of speciality will deliver the invited papers. They will provide a review of latest developments in these fields and establish a framework for the contributed papers in each session.

Computer-aided design (CAD), one of the fast developing areas in the scope of the conference will be highlighted by Professor Don Pederson of the University of California and Dr Willis A. Adcock of Texas Instruments. Contributed papers in CAD come from Japan, U.S.A., U.K., and Australia. The new device sessions include papers on magneto-sensitive and light-sensitive devices, thin films and analogs of biological devices. A novel integrated micromotor will also be described. These sessions are highlighted by Dr Eric Ash (Imperial College, London) and Professor J. Torkel Wallmark from Chalmers University, Sweden. Professor Eastman, from Cornell University will review microwave bulk-effect devices, then will follow six specialist papers.

Circuit and system theory sessions will be headed by Professor Charles Desoer (Berkeley) and Professor Douglas Lampard, Head of the Electrical Engineering Department at Monash. Besides Australian and American papers, these sessions include several contributions from India. The emphasis is on active filters.

The integrated circuit sessions include a linear IC program headed by James Solomon of Motorola who has personally been responsible for many new developments in this field. An IBM Fellow, David DeWitt, heads the digital IC session. In integrated subsystems there are two invited speakers: Dr F. L. Stumpers from Philips (Eindhoven) and Professor Murray Allen from the University of N.S.W. Technical papers range over subjects such as rocket instrumentation and modern computer architecture.

The program also includes sessions on IC packaging and technology, and properties of semi-conductors, as well as an inter-disciplinary session on biological systems in which the invited speaker is Professor Eisenberg from U.C.L.A. Finally, a panel discussion on educational problems in these diverse fields is being planned.

Prof. L. W. Davies *Dr. G. A. Rigby*

Registration forms and other details of the Conference are available from Mr K. G. Knight, Joint Conference Secretariat, The Institution of Radio and Electronics Engineers Australia, 157 Gloucester St., Sydney, 2001.

RADAR LOOKS OVER THE

Ever since its invention the use of radar has been restricted to line-of-sight operation. New techniques now being developed may extend the useful range to well beyond the horizon for some applications.

By Professor E. D. R. Shearman
(Dept. of Electronic and Electrical Engineering, University of Birmingham)

The civil and military users of modern microwave radars still have to accept roughly the same maximum range limit for tracking of ships and low-flying aircraft as faced the early radar pioneers, namely the horizon. This is because microwave radar waves travel in straight lines and can only bend round the curve of the earth by diffraction to a very limited extent and with high loss of energy.

A possible solution to this dilemma has been obvious for many years: to use the decametre wavelengths employed in high-frequency (HF) communication. Such waves are reflected back to the earth by the mirror in the sky formed by the ionised layers of the upper atmosphere, the ionosphere. Features on the ground beyond the horizon would thus be expected to become visible to the radar like a mirage of a distant oasis to a traveller in the desert.

Since this mechanism of radio-wave propagation is evidently so useful to short-wave communications, why do we not see as commonplace installations, shore-based, over-the-horizon radars tracking ships and aircraft a thousand kilometres away in mid-ocean? The reason is that there are a number of difficulties which have hindered such developments in the past. However, these are being overcome with modern techniques and knowledge, and some intriguing reports have been published concerning over-the-horizon radars for defence, without much indication as to how it is done. In this article an attempt will be made to show the basic reasons for the past difficulties and how new radar techniques and computer-assisted studies of the ionosphere and radio propagation make some of them less formidable. Some interesting possibilities for civil applications will also be mentioned.

Although tracking individual ships and aircraft is difficult, not much capability is needed to detect radar echoes from large areas of sea or land and this effect has been used for some years to study changes in the ionosphere over a large area of the earth from one station. The areas of the earth's surface seen are those to which the ionosphere reflects the radio waves, so that a radar map display ("plan position indicator" or PPI) of these illuminated areas of the kind shown in figure 1 tells the observer about the reflecting properties of the ionospheric layers responsible. Such PPI records show how an over-the-horizon radar has to be designed to survey a specified coverage area. First, however, something should be said about the way in which ionospheric layers reflect and absorb radio waves and how this varies through the day and with the transmitted frequency.

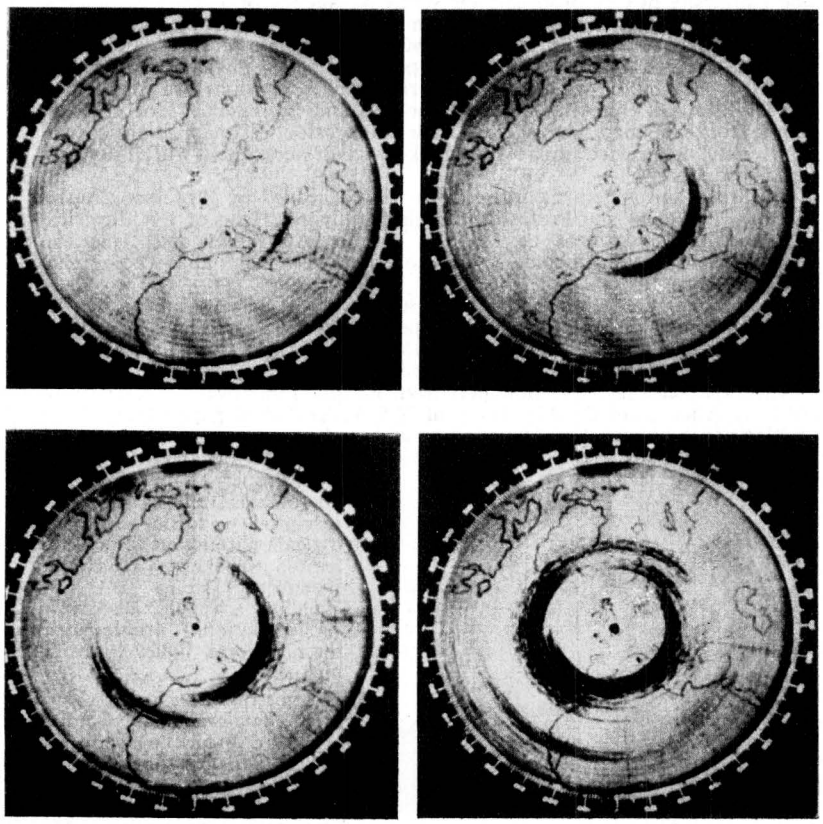


Figure 1. Echoes from ground and sea areas (black) illuminated by a 17MHz over-the-horizon radar (map superimposed).

Figures 2 (a) and (d) illustrate the most important features of reflection and absorption. Figure 2 (a) shows a condition which would be typical for a transmitted frequency of 25MHz in the middle of the night. It shows much the same state of affairs as in a line-of-sight microwave radar; the radio rays leaving the high-frequency transmitter are nearly straight since not much ionisation exists in the F layer (about 300KM high) which is the chief refracting or reflecting layer, nor is there much ionisation in the D layer (about 60KM high), which absorbs or weakens radio waves.

At dawn, with sunlight on the ionosphere, ionisation increases in the F layer and rays are just reflected at grazing angles and return to the earth beyond the "skip-distance" as shown at (b). At (c), later in the morning, rays up to quite steep angles are reflected, while at noon, (d), even vertical rays are returned to earth. (d) also illustrates the effect of the now densely ionised D layer, which absorbs the energy in the waves so that radar echoes may be too weak to detect.

The frequency of transmission also affects the nature of the reflections and (a) to (d) could equally represent what happens at noon as the frequency of transmission is reduced from 40MHz to 5MHz.

From these examples the first difficulty in operating an over-the horizon radar at high frequencies is evident. If a constant frequency of transmission is used, absorption will cause echoes to disappear at midday, while at night rays will escape through the layer and render detection impossible. To ensure coverage of a particular area we must vary the frequency with time of day. Thus, we make it low at night to permit reflection and high in daylight to avoid absorption, which decreases rapidly with increase in frequency.

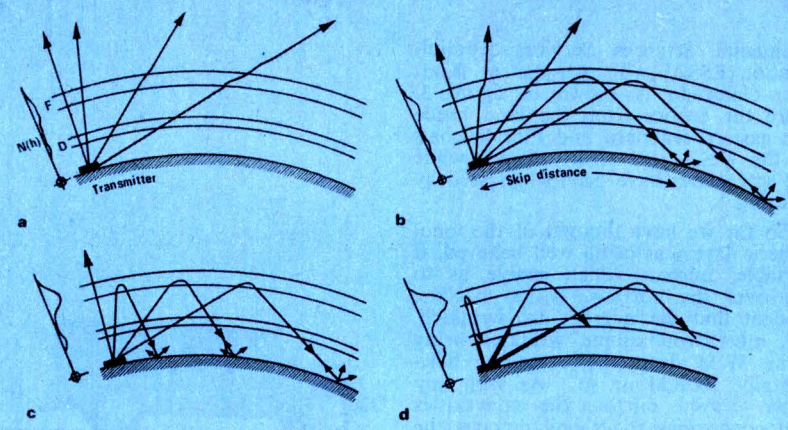
A further phenomenon is the geographical effect. If we look east or west,

EDGE

the local sun time will be different and the ionisation in the layers will be appropriate to those times. If we look north or south the local zenith angle of the sun will be different and the sunlight will have an altered ionising effect, greater if the sun is nearer the zenith. These effects can be seen in figure 1; the skip distance is shorter to the east in the early morning and shorter to the south than to the north at all times (in the northern hemisphere).

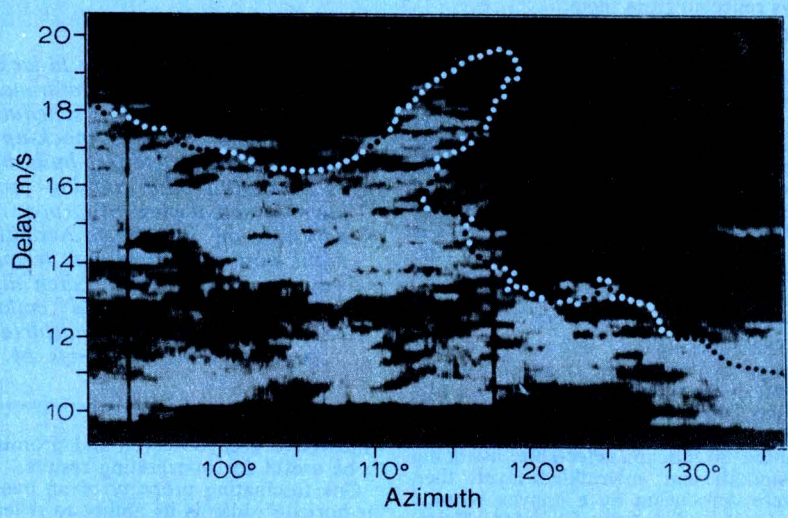
Having seen the main characteristics which govern the coverage area of an over-the-horizon radar, it is useful to look at the orders of magnitude of echoes from terrain and from man-made targets. In a typical night-time observation with a radar at Slough, England, for a transmitted pulse power of 100KW at 15MHz the received power from the earth's surface at 2200KM range was 300 micro-micro-watts. For comparison, an airliner might be expected to give an echo one-ten-thousandth of this "ground-clutter." The problem is thus one of detecting a tiny aircraft echo in the midst of large echoes from hills, houses, trees and other man-made and natural irregularities.

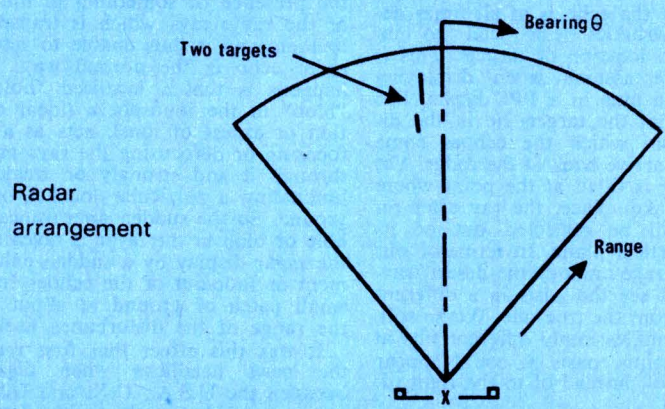
This is not so impossible as it sounds, since the motion of the aircraft doppler-shifts its echo and this frequency shift can be used to filter out the ground echo, as is done in airfield radars. Nevertheless the magnitudes here present a very different problem. A less testing application of this technique is in distinguishing between echoes returned by moving sea waves and those by stationary land, since both of these are large targets. A recent and striking demonstration of this technique by workers of the U.S. Envi-



TOP

Figure 2. Typical trajectories of radio waves through the F and D layers of the ionosphere for a fixed transmitted frequency at (a) midnight, (b) sunrise, (c) mid-morning, (d) noon. The profiles N(h) show how the ionisation density varies with height for each time.





CENTRE:

Figure 3. Over-the-horizon radar echoes seen at the ESSA Laboratories, Colorado. All echoes from the sea beyond the Florida coastline have been removed by filtering, using the doppler principle.

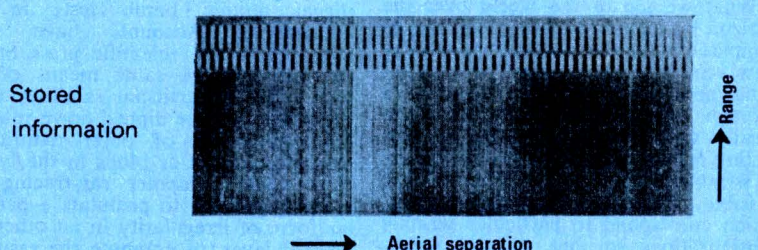


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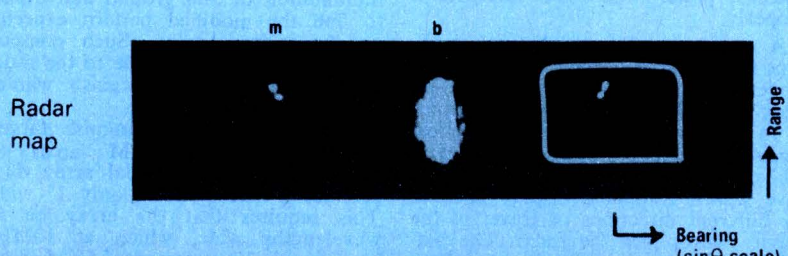
Figure 4. Sonar model tests of a variable spacing interferometer method for realising economically very large narrow-beam aerials. The two sets of fringes (centre) record the periodicity of the two targets. After optical processing a map showing target positions is produced (in rectangle, bottom picture).



ronmental Sciences Services Administration (ESSA) with a radar at Boulder, Colorado is shown in figure 3. Here the echoes from the land inside the eastern seaboard and Florida coast of the U.S.A. are clearly shown while the sea echoes have been suppressed by filtering.

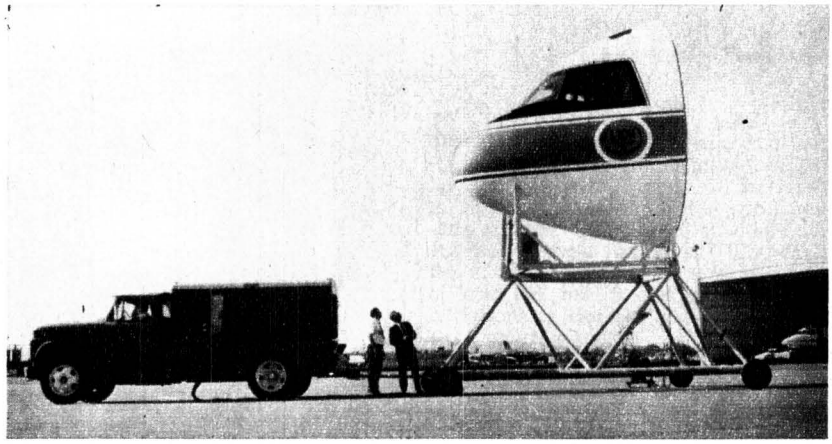
So far we have thought of the ionospheric layers as being well behaved, if variable, mirrors which enable us to see over the horizon. It has become evident that the mirrors are wrinkled, the most troublesome wrinkles being some 3KM deep and extending horizontally 100KM or so. As with any other curved mirror, the convexities and concavities focus and defocus the rays reflected from them.

One source of such wrinkles is gravity waves in the atmosphere. If we think of the atmosphere as an ocean of gas surrounding the earth, the outer surface of this ocean can have travelling waves upon it like the familiar ocean waves faced by sailors. Both phenomena are gravity waves, and in the atmosphere these extend further below the surface (which in any case is ill-defined and tenuous) than in the ocean and their effects may be seen at times in the wavelike high-altitude cloud patterns to which they give rise.

The focusing and defocusing of the energy by the layers is an embarrassment to over-the-horizon radar on two counts. If we choose the transmitter power and aerial system to ensure that wanted targets are detectable, assuming a smooth and unwrinkled layer, then severe defocusing by a convex wrinkle can cause a fade-out of wanted echoes. But even if the echo is at all times detectable, wrinkles can lead to inaccuracy in location of targets. This is because we assume when displaying echoes on a map in a PPI display like figure 1, that the targets lie in the direction from which the echoes come when they arrive back at the radar. Yet if the layer is tilted at the point where reflection takes place, the ray after reflection will be deflected out of its original vertical plane. In terms of our original mirage analogy the desert traveller would see the oasis in a different direction from the true one. Worse still, because wrinkles imply different tilts at different points, oasis A could appear to the left of, instead of to the right of, oasis B.

What we see of the world over the horizon by high-frequency radar can be compared with the undulating, warped view we see of the bottom of a swimming pool when looking down at it through the rippled water surface. Ideally we want some means of correcting for the distortion introduced by a wrinkled layer, or if this is not possible, a set of computed pictures which correspond to particular wrinkle configurations so that we can recognise the pattern seen and interpret it properly.

A major step forward in such problems has been taken with the aid of the modern digital computer. Scientists working for ESSA have used a computer to trace rays through a theoretical model of the ionosphere in which typical gravity waves are included and have shown computed display patterns for different directions of travel of the gravity waves past the radar. The patterns are very reminiscent of effects which have been observed and promise to be useful for interpreting results.



Is this the answer to the hi-jacking of American airliners? A detachable cockpit which flies automatically to Cuba, while the rest of the aircraft, continues to its scheduled destination? An intriguing thought, but actually this is a mock-up of the flight deck of the Lockheed L-1011 TriStar jetliner, built by the Lockheed-California Company as part of a pilot training program. It will allow future pilots to have an actual view of airport runways and see the effect of sun and darkness on instrument visibility. The full-size, fully instrumented flight station mockup can be mounted on a dolly and towed on runways, or positioned to catch different angles of the sun and airport night lights. A "blindfold" collar fitted with high intensity lights can be placed over the windshield to simulate night flying conditions and the blinding effects of lightning, etc., on crew members.

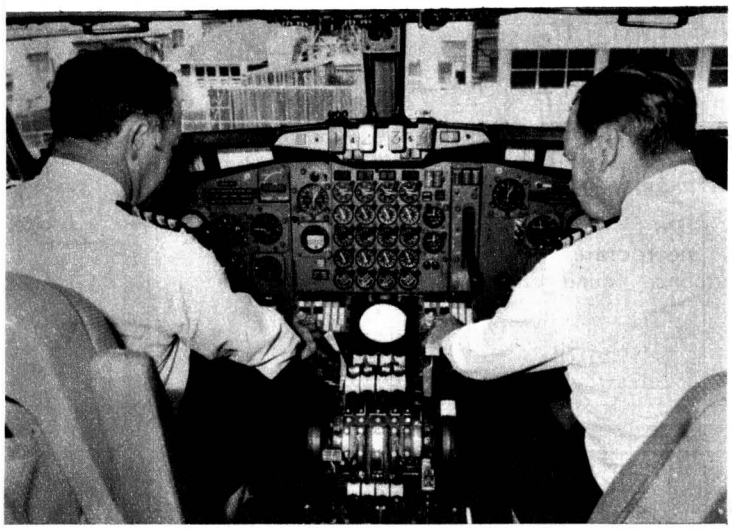
One fascinating property of an over-the-horizon radar is its ability to reveal the presence of something in the path of the radio rays which is transparent to them and is thus unable to return a radar echo in the normal way. What happens is that a localised "hole" or "blob" in the ionosphere (local depletion or excess of ions), acts as a lens, focusing or defocusing the rays passing through it and strongly or weakly illuminating a particular locality on the ground. So the sudden appearance of a hole or blob in the layer is revealed on the radar display by a sudden enhancement or fade-out of the echoes from a small patch of ground at about twice the range of the disturbance itself.

It was this effect that first reached the news headlines when discussed between the U.S.A., U.K. and U.S.S.R. as a possible method of detecting illegal atomic bomb tests in the atmosphere. Accounts have since appeared in the scientific press of the detection by the same means of the wakes left by artificial satellites when the satellites have dipped down into the ionosphere and of other natural or man-made holes or blobs in the layers. Here again computer ray-tracing has made it possible to postulate a particular form of irregularity in an otherwise normal layer, to compute the resulting illumination on the ground and thence to find the modified pattern expected on the radar display. Such computations are a valuable guide to the radar operator trying to distinguish wanted from spurious indications.

If a radar is to distinguish targets which are, say, 20KM apart at 1,000KM range, the aerial array must produce a narrow beam only 1° wide. This requires that the array be 50 wavelengths wide, which at 10MHz (wavelength 30 metres) is 1.5KM. Such enormous aerial systems consisting of 50 to 100 individual mast-mounted aerials are unknown in microwave radars and are another reason for the slowness in evolution of over-the-horizon radar.

It is clearly impossible to rotate such an array mechanically and the beam must be steered electronically, a further complication. An economic solution to both problems, which has been studied by Dr J. Clarke and the author at the University of Birmingham, is to adapt the synthetic aperture techniques pioneered in radio astronomy. Two mast-supported aerials only are needed, one fixed and one moving along a 1.5KM railway track in some 5-10 minutes. As the moving aerial travels along the track the signals from the two aerials are multiplied together and the product photographically recorded on film in the form of fringes, whose spacing bears information about the azimuthal bearing of the targets and whose vertical position is a measure of target range. The record is subsequently processed like an optical hologram, to which the technique is allied. Figure 4 shows the result of an experiment with a model of the full-scale system in which ultrasonic waves reflected from the underside of the rippled surface of a water tank represented radio waves reflected from the ionosphere. The final optically processed record faithfully represents the ranges and bearings of two targets situated on the bottom of the tank.

One reason for recent increased interest in over-the-horizon radar among those concerned with civil rather than military problems is the possibility, now becoming real, of tracking storm-associated wave systems in mid-ocean from a shore station. Recent work in Canada, the U.S.A. and Australia has given practical evidence of this potentially valuable meteorological aid. ■



AUTOMATIC TESTER FOR JUMBO JET ELECTRONICS

When the Qantas Boeing 747 jumbo jets come into service, the aircraft will be equipped with complex electronics systems. In preparation, Qantas servicing engineers are already training in the use of a computer directed servicing system, which is expected to reduce servicing time drastically.

By EDWARD ASHPOLE

As aircraft electronics, such as autopilots, automatic landing, altitude reporting and inertial systems, has grown in complexity, so have the servicing problems. As a result of this growing complexity, manual test equipment has become more costly, and the man hours needed for testing them have increased to an uneconomic degree. Because of the need for equipment to be on the service bench for long periods, enormously expensive replacement systems would have to be kept in instant readiness, to avoid lost flying time which would otherwise be unavoidable if aircraft had to be kept waiting while equipment was serviced. Inertial navigation systems for the Boeing 747s cost over $100,000, and with the currently used manual servicing procedures, two complete extra systems would need to be kept in service readiness so that instant replacement of faulty components could be guaranteed. The problem is therefore reaching critical proportions.

"The much publicised complete self-testing of an aircraft's components is still a long way off," says Charles Catt, Senior Electronics Engineer of Qantas. "It's true that on Boeing's new 747 some malfunctions can be detected by built-in test equipment, but this type of test does not isolate faults to a level that directs the repairman to the faulty component.

"As Qantas will be having four 747 aircraft in service next year, each one with three inertial navigation systems, we realised that something new was needed for their maintenance. So we decided to go all the way with a new generation of automatic electronic test equipment. We think this is the only practical answer for the maintenance of this fresh generation of aircraft. We believe all airlines must eventually come to use this system.

"One of the reasons we selected the present testing set-up was its ease of programming," he continued. "Most of the earlier generation of automatic testing machines had very great problems associated with their programming because this had to be done off-line. This meant that a tape was prepared away from the machine and then tried on the machine. When errors were found corrections had to be physically spliced into the program and then tried again. In the case of our automatic testing equipment the programming is on-line and can be carried out while testing is in progress. The technician simply types the program on a flexiwriter connected to the computer. If he makes an error — he may for example program a stimulus which is not available in the test facility — the teletype will immediately tell him of his error.

The automatic test equipment system that Qantas will install in its headquarters at Sydney Airport, consists of two test stations controlled by a CDC 1700 computer. Besides the inertial navigation systems, it will test autopilots and many other electronic systems carried in the 747s; and it is capable of testing two different components simultaneously. The system, manufactured by Societe National Industrielle Aerospatiale, of Toulouse, France, will achieve a drastic reduction in servicing bench space. This is made possible by an equally drastic reduction in servicing time. Some of the components which would require up to 42 hours on the service bench using the old manual testing procedures can be tested in under four hours using the computerised system.

A technician using the new set up to test an aircraft system simply brings it to the testing console, fits it into the testing jig and switches on. The testing procedures are then carried out entirely automatically by the computer.

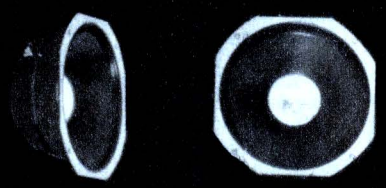
The test program is prepared from the equipment manufacturer's test specifications, and fed into the computer in the form of punched tape, where it is stored for future use on magnetic discs. All the technician has to do to initiate the testing procedure after plugging in the component is to select the appropriate test program by dialling. He can then select the mode of testing he needs by pressing the appropriate buttons on a control panel. These buttons are labelled for identification, e.g., "print out results," "print all failures only," "repeat," and so on. If he wishes, he can apply an individual test, or a series of tests from a particular program.

"With the manufacturer's trouble-shooting chart programmed into the computer along with the testing programs, the technician is supplied with type-out instructions from the computer when any system has failed one of its tests," says Catt. "By appropriate programming, these instructions can be detailed enough to direct his attention right down to individual components. The technician may also receive instructions on some particular action needed during the test. For example, he may have to read a dial of an instrument of the unit under test and feed this number, via an insert keyboard, into the computer, so that the computer can check it against the manufacturer's requirement.

"With this second generation of automatic testing equipment we can cut the times needed to test and service aircraft systems to about one tenth of what it now takes us. So we can get systems quickly back into service. We expect also that the new procedure will be more reliable and consistent in detecting faulty components.

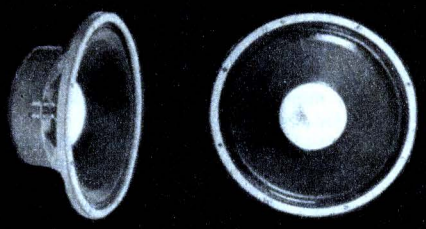
"But this is only the first step in automatic testing. Already manufacturers of radio equipment are designing equipment with special connectors, so that these too can be tested automatically. And probably by 1975 we will have advanced into this type of testing." ■

JBL Musical Instrument Loudspeakers



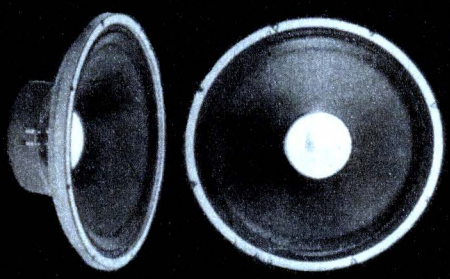
D110F SPECIFICATIONS

Nominal Diameter	10 inches
Magnetic structure	6 pounds
Impedance	8 ohms
Power Capacity	100 watts RMS
Voice coil diameter	3 inches
Voice coil material	Edgewound Aluminium Ribbon
Flux Density	10,200 Gauss
Total Flux	170,000 Maxwells



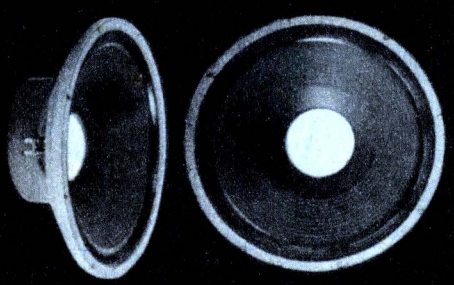
D120F SPECIFICATIONS

Nominal Diameter	12 inches
Magnetic structure	11 pounds
Impedance	8 ohms
Power Capacity	100 watts RMS
Voice coil diameter	4 inches
Voice coil material	Edgewound Aluminium Ribbon
Flux Density	12,000 Gauss
Total Flux	275,000 Maxwells



D130F SPECIFICATIONS

Nominal Diameter	15 inches
Magnetic structure	11 pounds
Impedance	8 ohms
Power Capacity	100 watts RMS
Voice coil diameter	4 inches
Voice coil material	Edgewound Aluminium Ribbon
Flux Density	12,000 Gauss
Total Flux	275,000 Maxwells



D140F SPECIFICATIONS

Nominal Diameter	15 inches
Magnetic structure	11 pounds
Impedance	8 ohms
Power Capacity	150 watts RMS
Voice coil diameter	4 inches
Voice coil material	Edgewound Copper Ribbon
Flux Density	11,500 Gauss
Total Flux	260,000 Maxwells

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World's First Deep-Sea Rescue

For the first time in the history of submarine operation, submariners entombed in vessels lying disabled in very deep water can hope for rescue with the recent launching of the U.S. Navy's first deep-submergence rescue vehicle (DSRV).

Developed by the Lockheed Missile and Space Company, the 49ft long DSRV is the first rescue submarine ever built. It was launched in a fully operational condition, complete with its full complement of complicated electronic search and navigational gear. The U.S. Navy will take delivery of the vessel later this year but tests and diving trials now being conducted will go on for some months, to be completed in 1971.

The DSRV is the primary element of a carefully planned rescue system which, on receipt of an emergency alert, will put the vessel in the water in any part of the world within 24 hours. Underneath the hull of the DSRV is a skirt which is designed to lock into position over a submarine's escape hatch. The DSRV has to be carefully manouvred into position to allow this mating operation to be completed.

The escape skirt is then sealed to the hull of the disabled vessel and pumped out to allow transfer of crew between the two vessels.

Upon notification that a submarine is lying disabled on the ocean floor, the DSRV will be loaded aboard a specially modified Lockheed C-141 aircraft and flown to the port nearest to the incident. The support equipment is carried in two more C-141s. At the chosen port, the DSRV is loaded aboard a "mother submarine" or a surface Submarine Rescue Ship, whichever is more readily available.

Officers of the U.S. Navy associated with the project say the DSRV is the most advanced deep-sea vessel in existence, incorporating many new materials and components in its construction. An integrated control and display (ICAD) system was specially developed for the DSRV by the Massachusetts Institute of Technology. This provides data from numerous sensors, including seven sonar systems and five closed circuit TV systems, to enable the crew to locate a sunken vessel and perform the tricky operation associated with joining the DRSV to a stricken submarine's escape hatch.

Basically, the rescue vehicle consists of a free flooding outer hull of glass reinforced plastic surrounding an inner pressure hull of three interconnecting steel spheres, each of 7½ft diameter. The forward sphere holds two crew and the navigation and control equipment. A third crew member and up to 24 rescued submariners can be accommodated in the two after spheres.

When carried by a mother submarine, the DSRV rides "piggyback" on its after-hatch and is carried to the scene of the disaster. The DSRV can be launched and recovered, and transfer rescued men, while the mother ship is submerged.

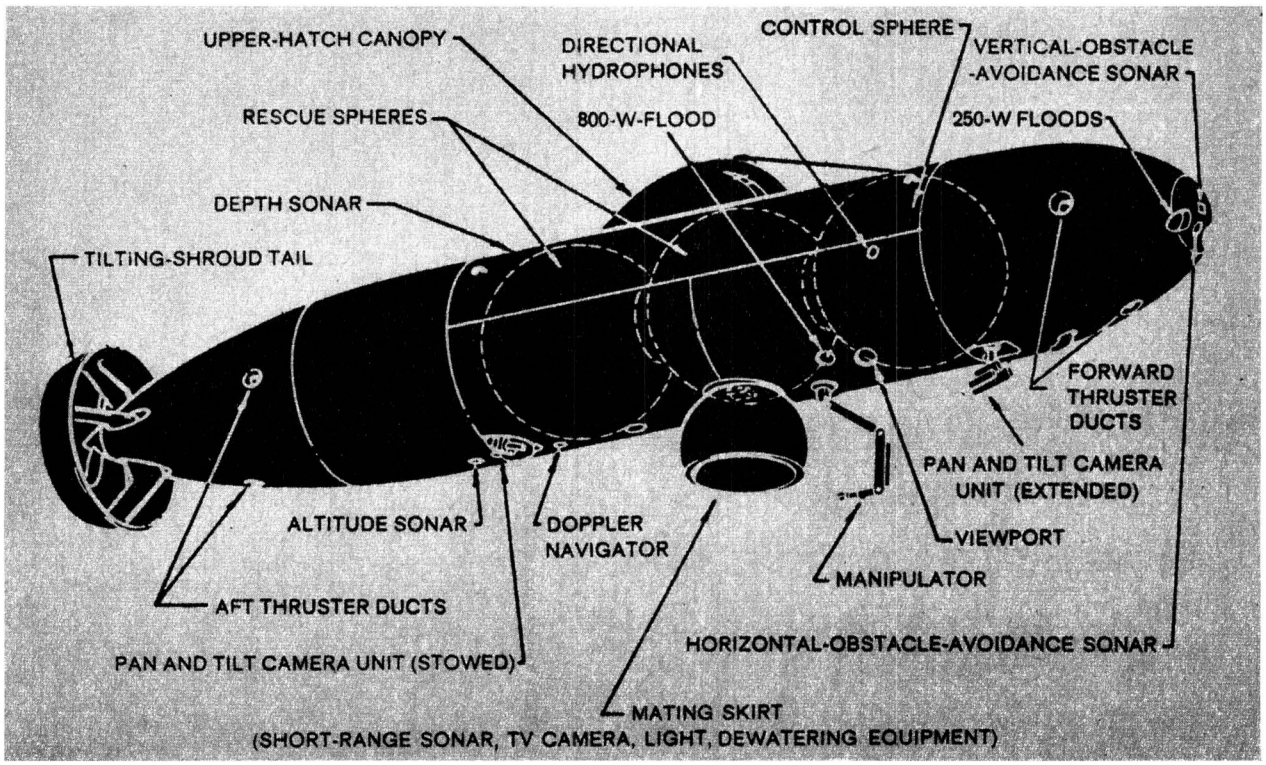
The sensor equipment carried in the DSRV is designed to allow it to home in on distress signals from a sunken submarine, perform search operations on a limited scale, and perform the necessary navigation, pilotage and attitude control. Figure 1 shows the locations of some sensors on the DSRV. During descent from the mother submarine, the DSRV will energise the horizontal and vertical obstacle avoidance sonars mounted on the bow. Range and bearing of any obstacles in the vessel's path are indicated on a sector scan CRT display on the pilot's display panel.

On the aft upper section of the hull is mounted a depth sonar sensor, which determines depth by measuring the time for sonar pulses to be reflected from the ocean surface. An altitude sonar under the hull operates in similar fashion to determine distance to the ocean floor. Depth and altitude information is presented digitally on the pilot's display panel, and is also used to produce an analog trace on a chart recorder.

When operating near the ocean floor, the DSRV uses a doppler sonar to measure its ground track. This is a four beam system which determines fore-aft and athwartship velocities. It can also be used to determine vertical velocity, which is required in the final stages of mating with the sunken (or mother) submarine. Velocity information is presented digitally to the pilot, and is also used by a central computer which computes dead-reckoning navigation.

It is anticipated that when the rescue vessel is mating with a disabled one, the mating operation will normally be assisted by means of the TV cameras and lights shown in figure 1, and by

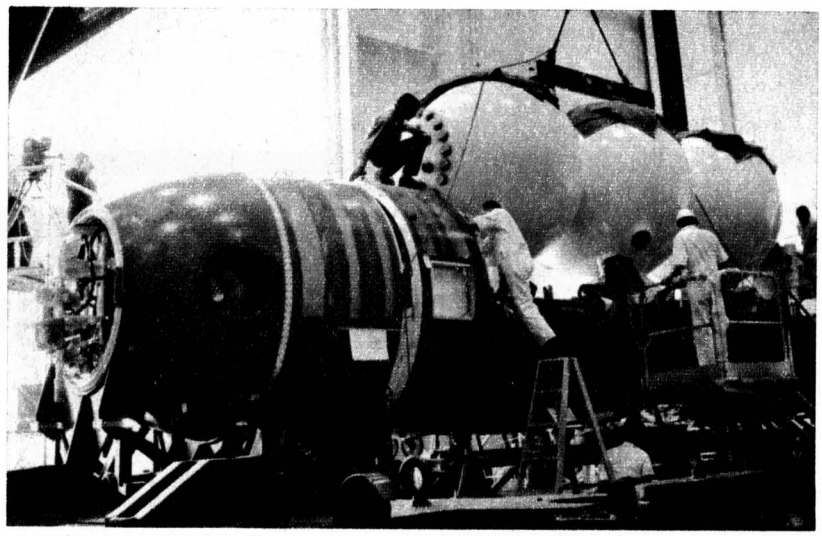
Figure 1. Equipment location on the DSRV.

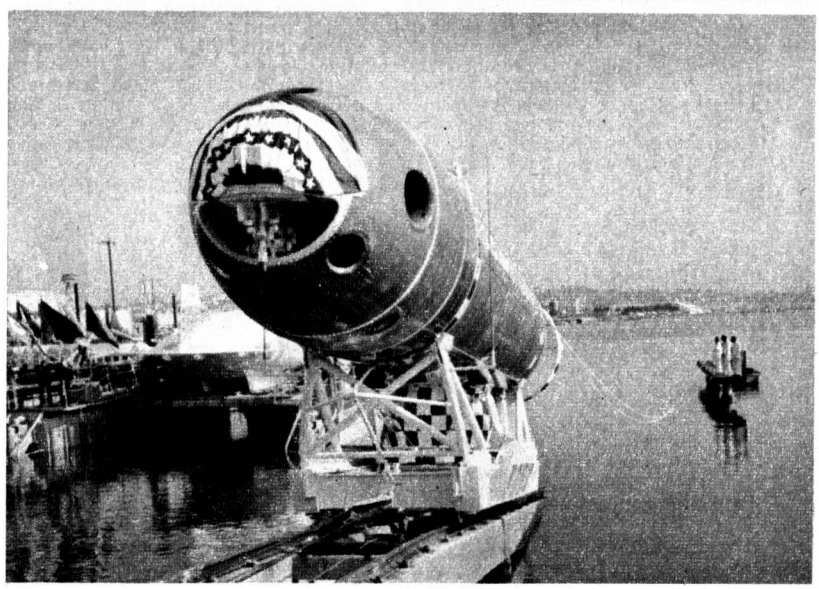


Submarine

observing the relative positions of the two vessels on monitors in the pilot's control panel. However, the designers have recognised that in some instances the surrounding waters may be too turbid for the TV system to be of much use. Under such circumstances, the DSRV will use a sonar system to pinpoint the sunken vessel's escape hatches.

The sonar to be used for this purpose is a dual-range type which represents a new concept in sonar. It is provided with a 150-ft range for use in making accurate determination of altitude, and a 15-ft range for use when locating escape hatches. Two transducers in the DSRV's mating skirt alternately scan the sector immediately below it. One transducer gives a fore-and-aft scan and presents a CRT trace of returns parallel to the DSRV axis; the other gives an athwartship scan to give a trace of the contour in the perpendicular direction.





TOP PICTURE:
The tri-spherical pressure hull of the DSRV being lowered into place in the outer hull.

CENTRE:
The DSRV slides down the marine railway during its launching at San Diego, California.

BOTTOM:
The DSRV being off-loaded from the C-141 cargo plane which will transport it to any part of the world at short notice.

As previously mentioned, the DSRV uses its doppler sonar for navigation. The vessel also has an elaborate set of navigational aids which work into a central processor computer. A miniature precision gyrocompass provides an accurate indication of heading. This is a three axis system, with three integrating gyros and two accelerometers as its sensors. In addition to heading information it provides (a) attitude information for the DSRV's stabilisation system (b) a reference for the computation of velocities for the doppler sonar; (c) position information by operating as a miniature inertial system.

As an alternative to dead reckoning, the DSRV navigate by means of transponders dropped from support vessels, or homing transponders which it carries itself.

The DSRV has vertical and horizontal thrusters which enable the vessel to be held in position over a sunken submarine against the pressure from water currents. The rescue crew can match the angle of the DSRV to that at which a sunken submarine is lying by pumping mercury between trim and list tanks to control the DSRV's roll and pitch angles. Rescues can be successfully completed at angles up to 45 degrees in either plane. ■

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GENERAL SPECIFICATIONS

Contact Rating 2 amps @ 240VAC, 5 amps @ 28VDC resistive load

Insulation Resistance 1000 megohms minimum

Dielectrical Strength 1000 volts r.m.s. at sea level

Electric Life 100,000 make and break cycles minimum on all models ending in 01 only; all other models 40,000 cycles 240 VAC — 39 VDC resistive load.

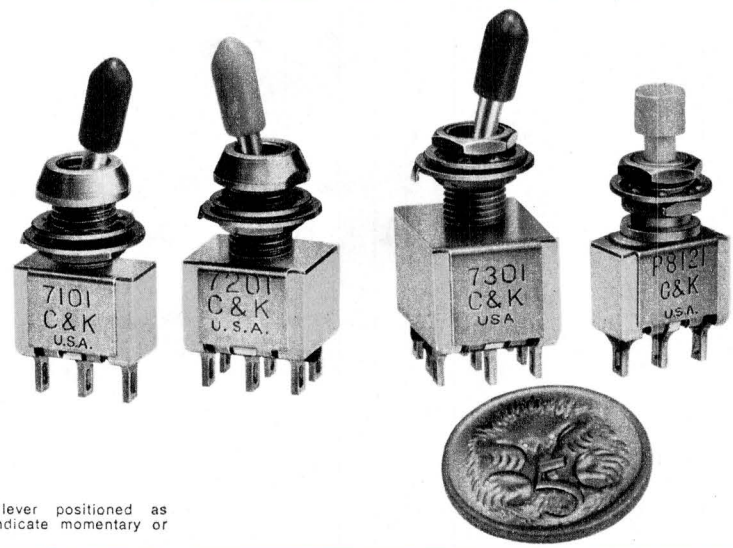
Initial Contact Resistance 10 milliohms maximum at 2-4 VDC, 1 amp.

Contacts Working contacts are Coin Silver.

Operating Lever Bright chrome plated brass bat handle toggle is standard; plastic colour caps supplied on request.

Case Material General purpose phenolic.

For further information please contact Professional Components Department, Villawood, N.S.W., or Ducon Interstate Offices.



Circuitry with toggle lever positioned as shown ( ) Parenthesis indicate momentary or non-locking position.

Model No.			Key-way
SPDT			
7101	ON	NONE	ON
7103	ON	OFF	ON
7105	(ON)	OFF	(ON)
7107	ON	OFF	(ON)
7109	NONE	ON	(ON)
7101 RPC	ON	NONE	ON
7103 RPC	ON	OFF	ON
7105 RPC	(ON)	OFF	(ON)
7107 RPC	ON	OFF	(ON)
7109 RPC	NONE	ON	(ON)

Model No.			Key-way
DPDT			
7201	ON	NONE	ON
7203	ON	OFF	ON
7205	(ON)	OFF	(ON)
7207	ON	OFF	(ON)
7209	NONE	ON	(ON)
7211	ON	ON	ON
7213	ON	ON	(ON)
7215	(ON)	ON	(ON)
3PDT			
7301	ON	NONE	ON
7303	ON	OFF	ON
7305	(ON)	OFF	(ON)
7307	ON	OFF	(ON)
7309	NONE	ON	(ON)

Model No.			Key-way
4PDT			
7401	ON	NONE	ON
7403	ON	OFF	ON
7405	(ON)	OFF	(ON)
7407	ON	OFF	(ON)
7409	NONE	ON	(ON)
7411	ON	ON	ON
7413	ON	ON	(ON)
7415	(ON)	ON	(ON)
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8221	DPDT		
8321	3PDT		
8421	4PDT		

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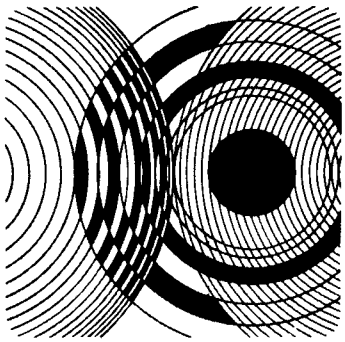


TECHNICAL DIGEST

Post Office designs automatic tester for reed relays

In anticipation of the wide use of reed relays as switching elements in processor controlled telephone exchanges during the next decade, the Post Office has developed a fully automatic tester for reed relays to evaluate their performance.

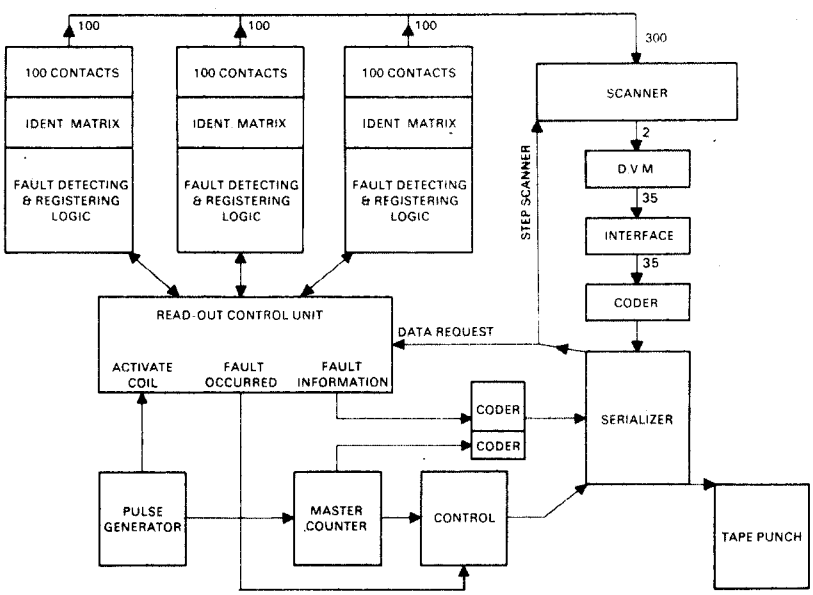
To assess the inherent reliability and likely failure modes of these devices, a comprehensive test program has been undertaken by the Post Office Research Laboratories on reed relays, made by several manufacturers.

The types examined, while all recommended for telephony switching, have differed in construction, size and reed contact material. The major parameters studied have been contact resistance, speed of operation, contact bounce and breakdown voltage.

In view of the large number of devices to be tested for up to 100 million operations, the test equipment needed to be highly automated, capable of continuous running with only minimal supervision, and with a data output suitable for direct computer analysis.

In its final form the test equipment designed and built by the Post Office research laboratories is capable of testing 300 reed inserts simultaneously under three different contact load conditions. The relays are operated at 750 operations a minute, with special error-detecting circuitry monitoring the opening and closing of each reed. If the time for these operations is outside a pre-set limit, this information is electronically stored as well as being visually displayed.

All the information stored is read out on to punch tape after each 1,000 operations. At pre-set intervals — normally 100,000 operations — the contact resistance of all reed inserts is read and recorded on punched tape. Computer analysis of the punched tape produces information regarding first and subsequent failures of each device in terms of timing faults and contact resistance at several levels. This information can then be used to make reliability predictions.



This block diagram shows the major elements of the Post Office's reed relay tester. Each reed is operated 12.5 times per second and is checked each time it is operated and released. If a relay is faulty, a lamp lights to indicate its position number. Periodically the numbers of faulty relays are recorded on punched paper tape.

Three types of contact switching conditions have been investigated. The first group of tests comprised switching of currents up to 100mA from voltage sources of 12-50 volts, generally with resistive loads. In another series of tests, the reeds did not switch load current, but a current was impressed while the contacts were closed. Further tests were conducted with no load current to check on mechanical life.

Reed inserts were found to fail in two major ways. Either the contact resistance reached a level which would be unacceptable in service (a value of 1 ohm is frequently assumed) or the reeds failed to open within the required time usually because of sticking caused by the interlocking of pips and craters formed by arcing. The magnitude of current being switched was found to be the controlling influence especially with respect to the sticking faults, and in those tests where no current was switched sticking faults were rare.

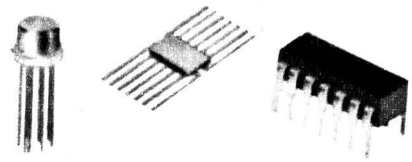
The contact resistance generally increased with the number of operations, but the rate of change was not uniform or unidirectional throughout the course of a test. A decrease in the voltage applied to the contacts was found to increase life, except for one type of reed.

This type had an extremely short life before failing by sticking if operated between 12 and 32 volts, yet if initially operated a few thousand times at 50 volts, no failure occurred and furthermore, failed devices could be restored by subsequent operation at 50 volts. This phenomenon was found to be due to the particular gas mixture used in the reed capsules.

In general it was found that the various types of reed relays had life expectancies in conformity with their manufacturers claims, providing the operating load conditions were within certain limits. Reeds switching low current or operating under "dry" circuit conditions were shown to be capable of several million operations without failure.

Under the conditions envisaged for telephone switching crosspoints, a failure rate of less than 0.005 per cent per million operations seems well within the capabilities of several types of reeds. ■

Mullard Electronic Components for COUNTING



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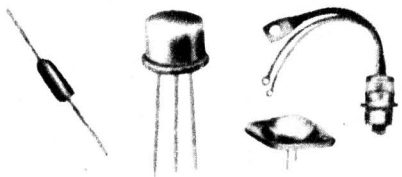

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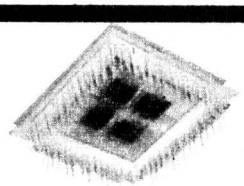

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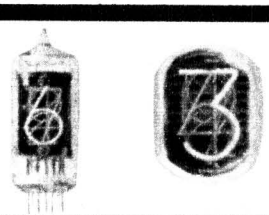

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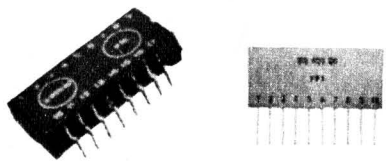

NORBIT 2, CIRCUIT BLOCKS

Mullard Norbit 2 includes sub-assemblies capable of solving industrial control problems using well established solid state techniques. Silicon semiconductors are used throughout so that an operating temperature range of from —10° C to 85° C is guaranteed, with speeds of up to 10 Kc/s. Each circuit block is a ready-made electronic sub-assembly designed to perform one of the basic functions in digital equipment. The range of circuit blocks includes pulse shapers, gate circuits, flip-flops, amplifiers, etc., to meet the requirements of digital systems engineers.

APPLICATIONS ENGINEERING SERVICE

This service operates in co-operation with, and at specific request of, commercial concerns requiring engineering assistance in the application of Mullard products. In addition, answers to technical enquiries are provided by the Technical Service Dept., where world-wide valve and semiconductor references are on file.

Mullard

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DIGEST

MAJOR ADVANCE IN LEAD ACID BATTERIES

New patents announced recently by Bell Telephone Laboratories, U.S.A., are for a new type of lead-acid cell which is claimed as a major advance on existing types; and a greatly simplified form of integrated circuit, smaller than a grain of sugar.

The account of the new lead-acid cell is taken from "Lead Battery Power," April, 1970, published by Australian Lead Development Association:

Aging tests on components of the new cells indicate a theoretical life under ideal conditions of 200 years, but the practical goal under typical service conditions is a more modest 30 years minimum.

Many thousands of huge lead stationary batteries are in emergency standby service throughout the world, protecting telephone and communications systems against power failure. They are used in computer installations, emergency lighting and many other applications. Twenty years' battery life is routine in such applications. Thirty years' life or more would bring major economies and even greater reliability to users. The Bell company itself has more than one million cells in service so that the new design will bring them major savings.

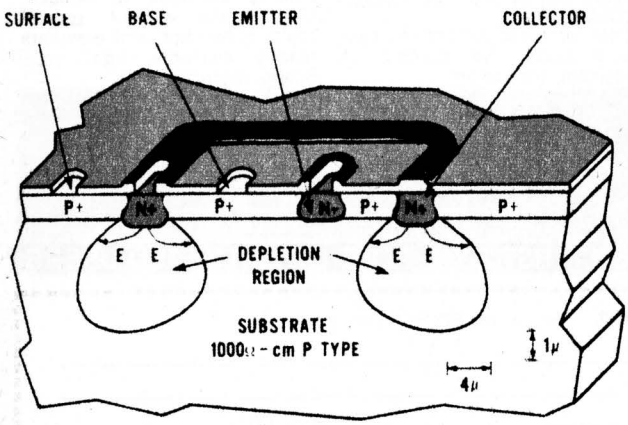
Lead-acid batteries have traditionally been constructed in a box-like configuration, with vertically disposed plates. This design has an attractive shape from several standpoints. It offers advantages in manufacture, while vertical plates are ideal for the escape of evolved gases.

In views of these advantages and the absence of any recognised shortcomings, there has been no significant reason to consider design changes. However, recent studies of the failure mechanisms of conventional batteries have brought the means to overcome the small deficiences which do exist.

Lead standby batteries normally "float" on line. That is, they are connected both to the mains power supply from which they are charged and to the equipment they are designed to protect. Except during emergencies they do not discharge.

Even under float service, however, there is some chemical activity. The positive grids slowly corrode and expand. As a result active materials fall away from the grids causing a drop in storage capacity. Bell researchers established that the main causes of battery failures after long service are short-circuiting and damaged containers due to grid expansion and buckling of plates.

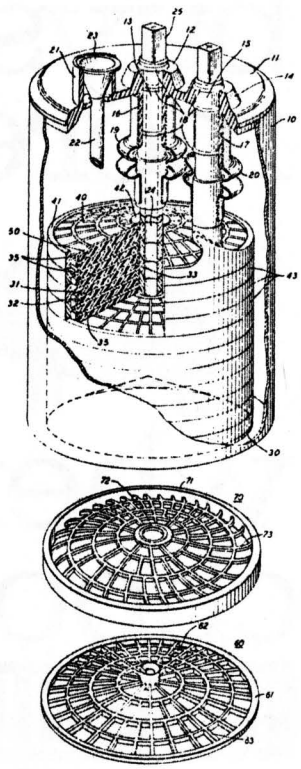
Instead of rectangular grids stacked side by side like pages in a book the Bell battery uses circular grids stacked one on top of the other like pancakes. Grids are made of pure lead instead of a lead alloy, and they do not grow as fast. When grid growth does occur it is geometrically even and predictable. It actually presses the active materials closer to the grids and battery capacity improves over a number of years.



General arrangement of the Tri Mask (TRIM) integrated circuit.

Design of positive and negative grids and cell configuration are indicated by the drawing (right). The circular positive grids, which are more susceptible to growth on aging, are provided with a strong peripheral retaining ring to counteract stresses. Construction of the cell imparts additional physical strength to the grid members. To provide for the evolution of gases, plates are inclined toward or away from the centre of the cell.

Test cells of 840 and 1680 ampere hours are now in production. Assembly is by largely manual processes, but Western Electric engineers are designing semi-automatic equipment to increase the production rate.



This diagram shows the construction of the new Bell lead-acid cell.

For nearly fifty years the users of communications systems all over the world have relied on lead stationary batteries for the outstandingly reliable service they receive. Developments such as the new Bell design ensure that lead batteries will continue to provide this protection far into the future.

The account of the new integrated circuit is taken from "Design Electronics," May, 1970:

The IC promises to be more economical to manufacture than contemporary circuits since fewer steps are involved in its production. In the normal way, ICs employing bipolar transistors require from five to seven photolitho masking operations before the contacts to the silicon are formed. This new circuit needs only three steps.

Known as Tri Mask (TRIM), it has a structure based on the use of lateral transistors, i.e., transistors in which injected carriers flow parallel to the surface rather than perpendicular to it. Collectors and emitters are diffused simultaneously and thus require only one masking operation. The Tri Mask method has been used to build IC logic gates, with a transistor in such a circuit occupying less than a millionth of a square inch.

Construction steps are given as follows. The substrate is silicon lightly doped with boron (P-type substrate) and into this is diffused a shallow P-type base layer. Silicon oxide is grown over the entire surface and is then etched away selectively where the emitter and collector regions are to be formed. The first photolitho mask is used for this step. Phosphorus-doped emitter and collector regions (N-type) are diffused through the P-type base and then the whole of the exposed silicon oxide is removed.

A second silicon oxide layer is grown on the surface and the second mask defines the emitter, collector, base and surface contact holes. Metal is evaporated over the entire surface and then etched away except in regions where the third mask defines the metal conductor paths. In the Bell system, the contacts to external circuitry are provided through beam leads, while a layer of silicon nitride provides the protection.

Tri Mask devices are capable of giving the same low shape and stable threshold characteristics of conventional bipolar transistors. ■

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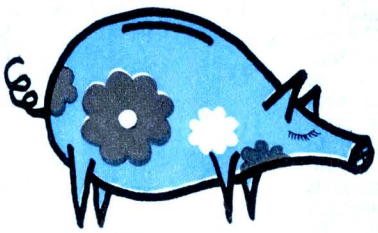

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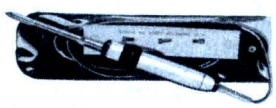

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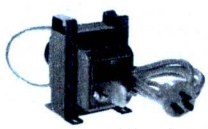

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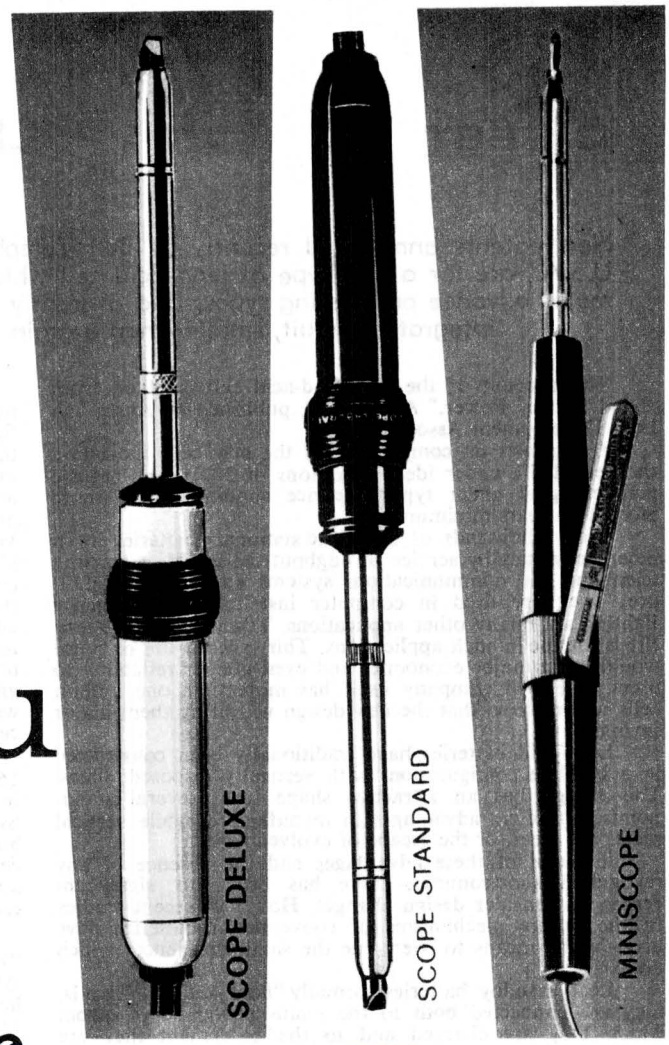

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DIGEST

BROADCAST SYSTEM WARNS OF TRAFFIC CONGESTION

A West German manufacturer of electronic equipment has proposed a system for setting up a network of VHF FM broadcast stations which will provide motorists with information about traffic congestion and hazardous conditions, in addition to providing an entertainment program. A feature of the proposed system is that motorists can receive the traffic information even if they are listening to any other channel, or a tape recorder.

broadcasts about road and traffic conditions can do a lot to ease traffic jams by warning motorists to use alternative routes. But such broadcasts can only be really effective if every motorist in a certain area gets the message. The alert must get through even if the driver is tuned to the other station, listening to his car's tape system, or riding in a car with no standard entertainment equipment at all.

A system that can get the word through despite these obstacles has been demonstrated by Schaub-Lorenz, a West German subsidiary of the International Telephone and Telegraph Corp. and a big entertainment-electronics producer there. The new system is in the running for adoption by the nation's Fourth Radio Program, which will be set aside for traffic reports. Schaub-Lorenz has named its system Infar, an acronym for the German words for "information broadcasting by automatic radio."

The operation of the Schaub-Lorenz system is simple. The signals the traffic station transmits are picked up by a small VHF tuner unit in the car. The station will be transmitting a normal entertainment type program for most of the time, as well as an inaudible 19KHz pilot tone. When traffic information is broadcast this pilot tone is switched off for the duration of the announcement.

A driver who has his receiver tuned to the traffic station will naturally hear the broadcasts relating to traffic. The problem is to ensure that those who are tuned to a different station also hear the announcements. It is the interruption to the 19KHz tone which allows this to happen. When the pilot is switched off the channel to which the driver is listening is cut out and the traffic station is cut in. The pilot tone can also cut out a tape player.

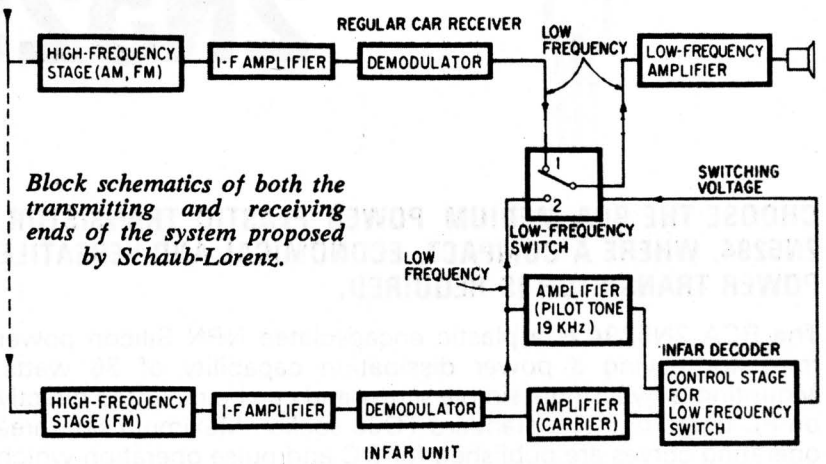
However, unwanted channel switching would occur if the car travels through a zone of radio silence, such as a tunnel or high-rise building area. To prevent such unwanted switching, Schaub-Lorenz engineers established a second criterion. The carrier of the traffic radio station must be present before channel switching can take place. This is done by a simple AND circuit; a control signal is generated only when the pilot tone is interrupted and the carrier of the traffic station is present.

Infar has several strong points. For one thing, it should be easy to implement, because the pilot tone system is compatible with existing stereo broadcast transmission standards, where a pilot tone is also used. Although the new channel would not necessarily be transmitting stereo, existing hardware could be used to provide the 19KHz pilot tone.

Another advantage is that the additional electronics gear required in the car can be held to a relatively low cost. The Infar unit is nothing but an ultra-shortwave receiving unit whose design can be kept simple since it need only operate in the 100MHz to 104MHz range. Thus, a broad-band front end and a simple tuning system could be used. For tuning, some fixed or pre-tuned circuit arrangement, or an electronic tuning scheme, is feasible in any future mass-produced Infar units. Furthermore, it doesn't require a low-frequency portion or a loudspeaker. Infar operates into the audio stage and loudspeaker of the normal car receiver.

Other parts of the Infar unit — the AND circuit, for example—could be based on integrated circuits, and this would further keep costs down. Schaub-Lorenz figures that once the Infar unit is mass-produced, it could well sell for less than $30.

What about those drivers who don't want to bother with a car radio? The Infar unit itself can come complete with an audio stage and a loudspeaker. The unit would sound off only when the pilot tone is interrupted. The unit would be so connected as to come on whenever the ignition is on. ("Electronics," May 11, 1970.) ■



Block schematics of both the transmitting and receiving ends of the system proposed by Schaub-Lorenz.

Numbering of Integrated Circuits

The March-April, 1970, issue of "Mullard Outlook" contains the following explanation of the system used by Mullard (and some other companies) for the numbering of integrated circuits.

The Mullard type numbering system is in accordance with the rules of Pro-Electron, the European organisation for type number standardisation. A considerable advantage of this system is that the letters and digits have a meaning and hence enable the user to recognise and memorise type numbers more readily.

The type number consists of three letters followed by three digits, with the option of a suffix letter at the end.

The first two letters denote a family of individual devices. The first letter for a digital family is F or G. The second letters are used in alphabetical order, and for digital families denote a particular family of circuits. The third letter denotes the function.

The first two digits are the serial number of the particular function in any family. The last digit denotes the ambient temperature range. The suffix letter denotes a variant. For example, for TTL devices:

The Third Letter — Function

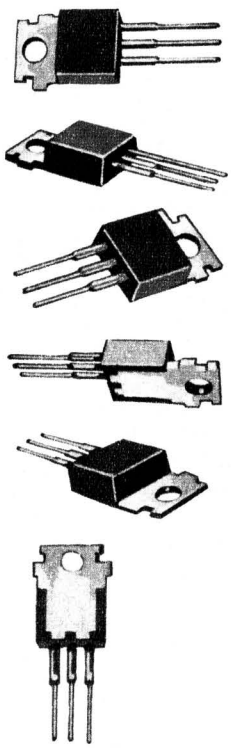
H Gates or gate arrays and similar circuits
J Bistable or multistable sequential circuit (e.g. flip-flop, register, counter)
K Monostable circuit
L Level converter circuit
Y Miscellaneous

The Last Digit — Temperature

1 0 to +70°C
2 —55 to +125°C
6 —40 to +85°C

The Suffix Letters — Variant

No Suffix All plastic dual-in-line
A Hermetic-in-plastic DIL
B Flat pack ■



RCA Power Transistor 2N5294

CHOOSE THE RCA MEDIUM POWER PLASTIC TRANSISTOR, 2N5294, WHERE A COMPACT, ECONOMICAL AND VERSATILE POWER TRANSISTOR IS REQUIRED.

The RCA 2N5294 is a plastic encapsulated NPN Silicon power transistor having a power dissipation capability of 36 watts. Mounting is by a single simple screw and can be mounted directly on PC board or into a standard TO66 socket. Maximum safe-area operating curves are published for DC and pulse operation which assists in the design of reliable equipment.

This transistor is an excellent direct substitute replacement for the 2N3054 and 40250 transistors.

The 2N5294 can be used in: — Audio Amplifiers
Regulated power supplies
Power inverters and converters
and many other applications.

The major electrical characteristics of the 2N5294 are as follows:—

V_{CEO}		70 V
V_{CER}	(1)	75 V
I_C		4 A
h_{FE}	(2)	30-120
f_T		0.8 MHz
$R\,\theta_{j\text{-}c}$		3.5° C/W
V_{CE}(sat)	(2)	1.0 V
T_j max		150° C

Note: 1. $R_{BE} = 100\,\Omega$
2. $I_C = 0.5$ A

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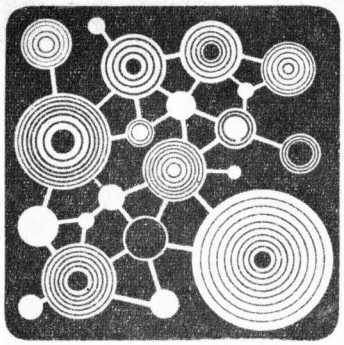


SCIENTIFIC AND INDUSTRIAL NEWS

British exhibitions

Scotland's international engineering exhibition, NORBEX, will take place from September 8 to 12, at the Kelvin Hall, Glasgow. Products and processes to be shown or demonstrated include machine tools, welding equipment, fluid power, and diecasting. Electronic components and control instrumentation will be segregated as a separate exhibition. A symposium on machine tools and productivity will take place during the exhibition. Details may be obtained from the organisers, Lintex Ltd., 224 Grand Buildings, Trafalgar Square, London, W.C.2, England.

This year's Bio-Medical Engineering Exhibition will be held in the West Hall, Olympia, London, W.14, from September 15 to 18. The Biological Engineering Society is arranging a series of lectures as an integral feature of the exhibition. In addition, the society will be responsible for a section of the exhibition devoted to special research projects. Details of the exhibition and lectures may be obtained from the organisers, U.T.P. Exhibitions Ltd., 36-37 Furnival Street, London, E.C.4, England.

Steering laser beams

Bell Telephone Laboratories in the U.S.A. has developed a technique for depositing lightguides on a glass plate similar to the methods already well known to the semiconductor industry in that the guides are "sputtered" on to the substrate. Based on the well-known light-pipe principle, a lightguide is a hair-like transparent pipe that will enable laser light to be manipulated as though it were a current in an electronic circuit. Although still at the research stage, Bell scientists claim that lightguides can be connected together to form complex optical circuits capable of performing the necessary signal processing in computer or communications equipment.

The lightguides are about 100 times thinner than a human hair and a complete and complex circuit can easily be fitted on a 5c piece. Complicated circuits can easily be made by photolithographic processes for reproducing a prototype. The circuits are robust and relatively unaffected by heat, noise or vibrations. Another development will enable the lightguide to be used as an "in-line" laser by doping the glass with an appropriate additive such as neadymium. Pulses can be generated by attaching an energy source to the transmission line.

High density data store

A data recording system that can pack approximately 40 times more digital information on a given length of magnetic tape than present systems has been developed in the U.S.A. by General Dynamics. Called the Unidar system, it will be used initially for a data acquisition requirement for the U.S. Government, but it may eventually have commercial applications in accounting, inventory control, library reference, and other information retrieval systems. The system uses a proprietary recording technique for which patents are pending.

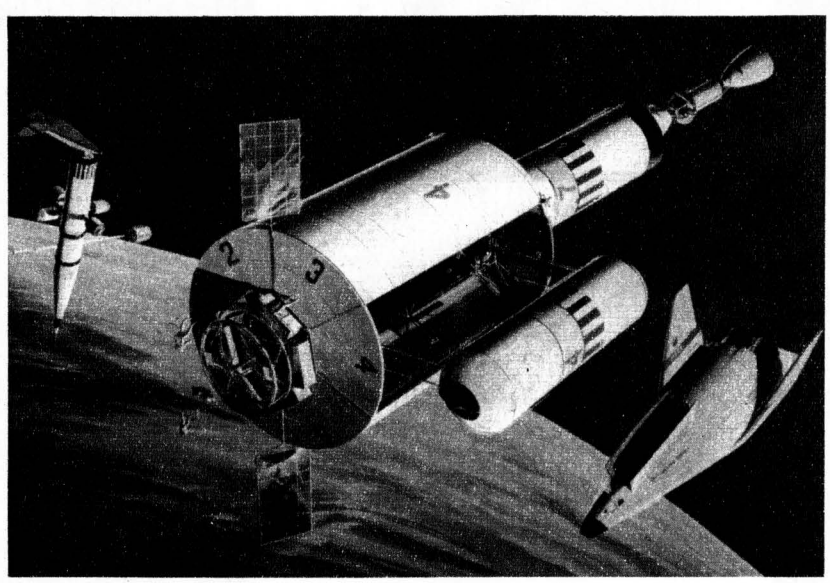
The system, which employs standard wideband instrumentation magnetic tapes and instrumentation-type tape transports, can be used with existing computers. Conventional magnetic tape recorders store digital data at rates of the order of 800 bits per magnetic track inch. The present capability of the Unidar system is 33,300 bits per track inch. The data acquisition system being built by General Dynamics will store data at approximately 84 million bits per second using 21 tracks on a 1in tape.

In one possible commercial application, data must be

Nuclear space shuttle

Two versions of the nuclear shuttle, a self-sufficient vehicle that will shuttle payloads between earth orbit and lunar orbit and between different earth orbits, are taking shape at the Lockheed Missiles and Space Co. in California, U.S.A. Along with three other systems (an earth-to-orbit space shuttle, a space station, and a "space tug") the muclear shuttle is part of a projected network to carry men through space on a variety of missions.

One version of the vehicle is a large single-tank system that would be launched only partially fuelled. The system would be filled with fuel in orbit by an earth-to-orbit shuttle. The second version involves a skeletal framework that would be launched into space, assembled in orbit, and completed with fuel tanks brought up by earth-to-orbit shuttles. Lockheed has teamed with the Boeing Co. to seek one of the NASA design contracts for the earth-to-orbit shuttle.



An artist's concept of an earth-to-orbit space shuttle (lower right) ejecting a full fuel tank towards a waiting nuclear shuttle during a space refuelling operation. The object in the left background is one concept of an orbiting space station.

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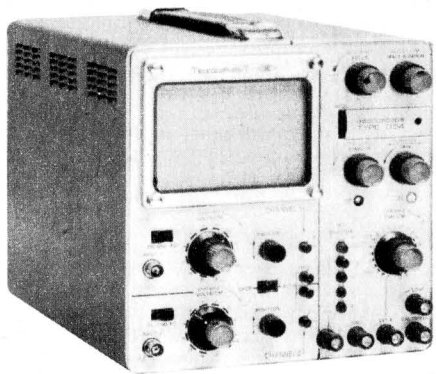

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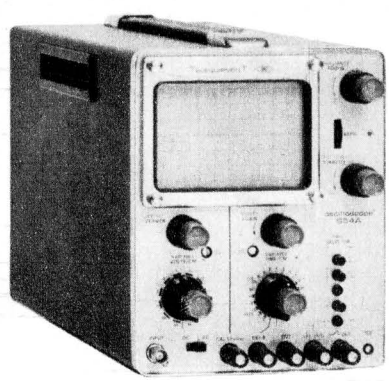

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searched for specific information on the service history and other status of a particular customer. With Unidar techniques, access can be provided within four seconds to the desired data contained within an almost infinite data bank, according to a company spokesman.

HF combat radio

A new HF combat radio with 285,000 synthesiser-controlled channels between 1.5 and 30MHz has been produced by Racal-BCC Ltd., in the U.K. Called the BCC34, it includes a fully automatic aerial matching and tuning system, and has a built-in remote control facility for operation up to half a mile distant. Power output is 25 watts which can be increased to 100 watts with a linear amplifier unit. Modes of operation are SSB, AM, CW and FSK. With a weight of 18lb and a volume less than a quarter of a cubic foot, the BCC34 can be used as a manpack set, in fighting vehicles, or as a fixed base unit. (Racal-BCC Ltd., Western Road, Bracknell, Berks. RG12 1RG, England).

Information for air passengers

The passenger information system at Sydney's new international air terminal is claimed to be the first in the world to use both complete and abridged presentation. The system includes 2000 loudspeakers, 90 amplifiers (with automatic level controllers), computers, TV cameras and equipment, and 15 flight information boards. A programmed public address system gives information only to the particular areas of interest, such as arrival information to the arrival hall only. Passenger holding areas adjacent to the aircraft docking positions are also equipped with individual P.A. systems.

Announcements are made by a D.C.A. controller who co-ordinates these with visual announcements displayed on specially designed information boards. The flight information displays, at a number of strategic points, give precise information concerning each flight. The displays take the form of large boards which list the airline, flight number, origin, destination, scheduled arrival and departure times, gate number, etc., in chronological order. In addition, abridged visual information is given through yet another series of electronically controlled information boards. The complex was installed by Simon Gray Pty. Ltd., distributors for Autophon Passenger Flight Information Systems.

Precision drawing aid

A drawing aid has been developed at Marconi for all precision layout work, including master layouts for printed wiring boards, with a positional accuracy consistently better than .005in, an accuracy unattainable by sight alone. The inventor is Mr Alfred Clark, a design engineer in the Marconi Aeronautical Division, Basildon, Essex, England. His technique uses a special grid under the drawing sheet as a precision reference for adhesive lines and symbols. By 4:1 photographic reduction from master layouts made by the grid technique, a dimensional accuracy better than .0015in is achieved on printed wiring boards made at Marconi.

The basis of the new technique is a precision solid nickel grid on which is mounted a translucent drawing sheet. A freehand sketch on translucent material may be laid as a guide between the drawing sheet and grid. The grid has square holes at intervals of 0.1in vertically and horizontally, with an accuracy better than .003in. A pin or stylus pushed through the drawing sheet locates precisely in the centre of one of the holes in the grid. This then acts as an accurate reference from which adhesive tape lines and symbols can be positioned on the drawing.

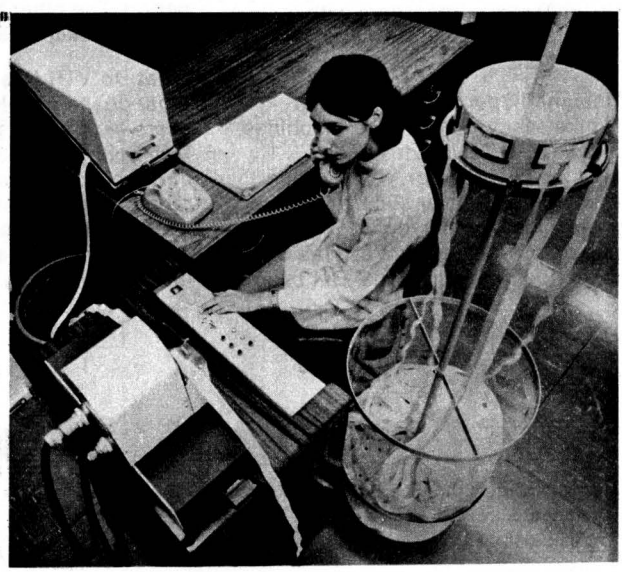
Adhesive symbols are picked from a dispenser using a special stylus. The symbol is located on the shank of the stylus which is then pushed through the drawing into a grid hole. A collar presses the symbol on to the drawing concentrically with the grid hole. Lines are drawn using a ruler held against pins as a guide for a tape laying tool. A specially shaped ruler enables parallel lines to be drawn at intervals as small as .001in. Holes pierced in the drawing sheet have slight projections underneath which are useful in relocating the sheet on the grid (for corrections to be made) with the original accuracy.

Ships navigation system

A navigation system opened recently at Port Hedland, W.A., is the first electronic guidance chain on the Australian coast. Installed by the Decca Navigator Co. Ltd. at a cost of $1.5 million, the system allows the large bulk ore carriers shipping ore from Mount Newman to navigate the extremely difficult passage out of Port Hedland with a minimum of risk and difficulty.

Trans-Tasman data link

A high speed data transmission link has been set up between the Sydney head office of Overseas Containers Australia Pty. Ltd. and New Zealand ready for the start of container shipping in that country early in 1971. Standard Telephones and Cables Pty. Ltd. provided units for similar links between Sydney and the other Australian States before the first container ship arrived. The data link to New Zealand is already receiving information about the likely demand from various centres and the allocation between ports of the 2200 containers which appear likely to be required. As happened in Australia, there will be a period of simulation exercises in which "ghost" ships will be moved between New Zealand ports, and loaded and unloaded according to requirements sent through the data links.



The STC high speed data transmission unit in operation at the head office of Overseas Containers Australia Pty. Ltd. in Sydney.

IVC
International Video Corporation

STRAIGHT TALK ABOUT SELECTING A VTR FORMAT

Selecting the right 1-inch format is a major decision facing those who recognize the superiority of 1-inch recorders over smaller width tape machines with their inherent limitations. With some pardonable pride we point to the fact that there is a trend toward the IVC 1-inch format. People buying recorders for the first time are selecting the IVC format and they are being joined by users switching from competitive formats. In fact, last year IVC sold nearly 2,000 1-inch color videotape recorders into closed circuit, ETV, CATV and broadcast television applications.

The reasons for this trend lie in both IVC's product and IVC's format. IVC's careful attention to quality assurance has established an outstanding record of customer confidence in IVC recorders.

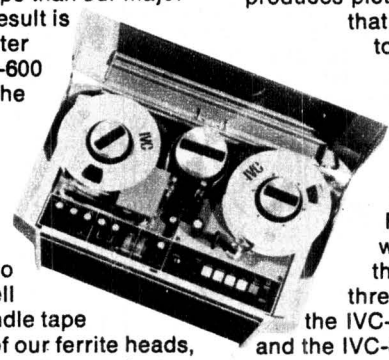
The First Single Standard 1-Inch Format
Unlike others in the VTR field, we guarantee tape interchangeability across the board, color or monochrome, on the 1-inch standard in all our VTR's, including both broadcast and closed circuit recorders. No separate high-band, low-band 1-inch standards.

For instance, a color tape recorded on our $15,000 broadcast recorder (IVC-900 series) can be played back on our low cost monochrome unit (IVC-600PB) priced at $1,980 A tape recorded on our IVC-600 color recorder $3,400 can be played back on all IVC-900 series recorders with absolute interchangeability. No exceptions to the rule.

Designed Specifically for Color
Unlike many competitive machines, all of our VTR's are designed specifically for color, which is one reason they deliver such reliable, professional quality color. Of course, our color recorders are available in monochrome versions. But even these "monochrome" VTR's record color signals, and their tapes will play back in color on any IVC color recorder or playback unit. All IVC monochrome VTR's can be upgraded to color by adding a plug-in printed circuit board.

Instant Video Confidence
No other VTR offers Instant Video Confidence, an amazing new feature that lets you watch your recording being played back on a monitor *as it is being recorded.* You always know that you are making a "good" recording.

The Most Economical Format to Operate
Our VTR's record and play back for one hour on a small 8″ reel using 30% less tape than our major competitor. The result is a smaller and lighter recorder (the IVC-600 weighs 47 lbs. in the case). In addition to accepting the standard 8″ reel, the IVC-900 will record for 3¼ hours on a 12½″ reel. We could also talk about how well our recorders handle tape and the long life of our ferrite heads, but you'd learn more if you asked an IVC owner about that. Speaking of tape, you shouldn't overlook the fact that of the three leading 1-inch VTR manufacturers only IVC permits use of 3M or Memorex videotape during the warranty period. The other two *require* their own brands for warranty coverage.



What Do VTR Users Say?
What do the people who count—the users — think of the IVC format? Members of the National Association of Educational Broadcasters recently heard results of a survey of over 1,678 users of VTR's conducted nationally by Northern Illinois University. Seven hundred and forty-six responded to the questionnaires. A portion of the group chose to answer the question: If you were to start over today and replace your VTR, what brand would you select? The answer:

49% said IVC
27% said Sony
14% said Ampex

In addition, no one who owned an IVC format recorder indicated any desire to switch to any other format.

One of the reasons for this decided preference for IVC recorders may have been revealed by an extensive survey conducted a few months ago by the Swedish Committee for Television and Radio in Education. The basic question was: Which recorder produces picture quality that is most conducive to learning by television? There were four groupings, the highest group was the "most recommended." Four recorders were selected for the highest category — three of these were the IVC-600, IVC-800, and the IVC-800 with editor.

These reports reflect customer recognition of the basic advantages of the IVC format — a recorder with a combination of practical working features designed for the user. Whether you are concerned about selecting the right format or are thinking about switching from another format, let us show you what we're talking about. For a comparison chart of performance specifications of competitive 1-inch recorders.

BOB BAMFORTH,
A.V.E.,
7 THE CRESCENT,
ANNANDALE.

AUSTRALIAN VIDEO ENGINEERING

7 The Crescent
Annandale, N.S.W.
Tel. : 660-2644

50 Little Edward Street
Brisbane, Qld.
Tel. : 21 5422

496 Murray Street
Perth, W.A.
Tel. : 22 1911

622 Nicholson Street
North Fitzroy, Vic.
Tel. : 48 8115

Assembling PC boards

The Circuitmaster, manufactured in the U.K. by Vision Engineering Ltd. for printed circuit board assembly, is claimed to cut component insertion time by up to 60 per cent, to ensure accuracy of assembly, and to be suitable for operation by unskilled workers. An operator fits a board into a work holder, and then progressively moves an electrical stylus from one illuminated hole in a pre-drilled plastic guide board to the next, at the same time operating a button to cancel the light. The position of the stylus is sensed and the bin containing the correct component is illuminated with a flashing light. In addition, a centrally located flashing light shows whether the bin in located to the left, centre o right. The position for the component is clearly indicated by a projected light shining on the printed circuit board being built up. All bins are provided with polarity indicators and have a facility to mount a sample component alongside to assist the operator to mount all components the correct way round. (Vision Engineering Ltd., Send Road, Send, Woking, Surrey, England.)

Air collision avoidance

RCA in the U.S.A. has completed preliminary design fo a low-cost aircraft collision avoidance system. Feasibility of the system's critical element has been demonstrated in the laboratory and the total concept has been proved through computer simulation. The system, designated SECANT for Separation Control of Aircraft by Non-synchronous Techniques, will offer three equipment configurations all of which will work with one another. The simplest version is expected to be priced between $500 and $1,000.

All Secant-equipped aircraft within range of one another will exchange radio signals. By measuring characteristics of signals received in response to its interrogations, a signal processor can determine when a collision threat arises. The two larger versions also measure range and bearing of threatening aircraft and instruct the pilot on the best evasion manoeuvre. It offers horizontal as well as vertical escape routes, and can function either independently or can be integrated into a ground air traffic control system. It the latter case, Secant would automatically transmit a "hot-line" alert to the ground should a collision threat arise. (See also "Anti-collision systems for aircraft," in the January, 1970, issue, page 27.)

Miners' television

The Mining Industry Council plan to bring television to outlying mining towns is now dependent on the result of negotiations with six groups claiming royalties and reproduction rights of programs to be used by the stations. The Federal Government has amended the Broadcasting and Television Act to authorise the services; tenders have been called for construction of the low-powered repeater stations; but the final decision will not be made until the outcome of the negotiations is known.

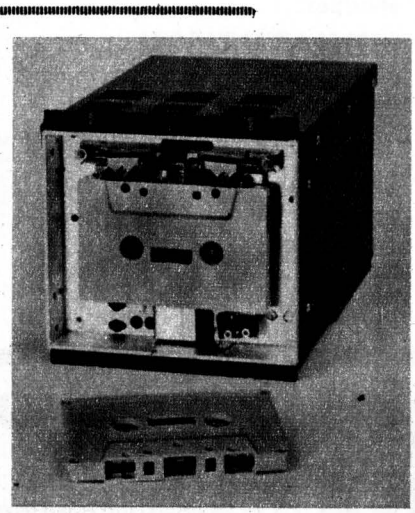
The Government has authorised the granting of licences to five mining companies for stations in: Queensland — Weipa (Commonwealth Aluminium Corporation Pty. Ltd.); Western Australia — Kolan Island and Cockatoo Island (Dampier Mining Co. Ltd.), Dampier, Karratha and Mount Tom Price (Hamersley Iron Pty. Ltd.); Northern Territory — Groote Eylandt (Groote Eylandt Mining Co. Pty. Ltd.). The stations are licensed specifically to serve the communities in the mining areas concerned. The stations will have no studios, but will transmit videotaped programs prepared by the A.B.C., which has established special recording centres. The stations would be on the air for 35 hours weekly. (See "Electronics Australia," June and July, 1969.)

N.Z. trade fair

The Department of Trade and Industry will stage an industrial trade display in Wellington, New Zealand, between July 20 and 24. The department has invited many of Australia's leading manufacturers to participate, including member companies of the Australian Telecommunications Development Association. Standard Telephones and Cables Pty. Ltd., has accepted the invitation and will display 5KW FM broadcast transmitter and a smaller all solid-state transmitter. The former will be on static display, but the latter will be a working display loading into an artificial aerial.

Cassette data recorder

A synchronous digital magnetic tape recorder which can store 140,000 characters on a single commercially available 1/8in tape cassette, and designed specifically for minicomputers and data terminals, has been developed in the U.S.A. by Mobark Instruments. Called the Mobark 200, the recorder incorporates read-write functions in a single 150 cu.in instrument, and has optional read-after-write capability. It can be supplied as a complete recorder, or as a transport mechanism only. It is capable of remote operation and can be rack or desk mounted. In the patented recording system used, incoming 8-bit BCD or ASC11 parallel data is strobed serially on to the tape by an optical positioning clock coupled to the drive capstan. Data blocks ranging from one to 70,000 characters in one length can be recorded.



A Mobark 200 recorder with panel removed to show the compact tape deck.

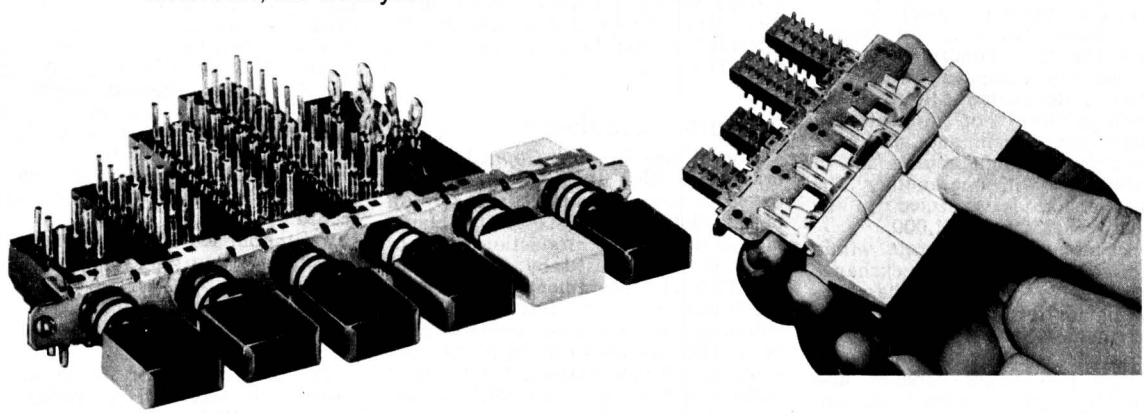
Applying photoresists

A roller coating machine, the R18, has been developed by Nubal Electronics Ltd. in the U.K. specifically to coat printed circuit boards with photoresists, lacquers and a wide range of chemicals. It applies very accurately controlled thicknesses of coating by employing the "doctor roller" principle. Instead of controlling the thickness by leaving a gap between the roller and the board, the layer is controlled by varying the pressure on a fully floating doctor roller. (Nubal Electronics Ltd., 186 Oatlands Drive, Weybridge, Surrey, England.)

New from McMurdo:

Push-button & Piano-key SWITCHES

McMurdo brings to Australia . . .
EUROPE'S GREATEST MODULAR SWITCHES
for professional and entertainment electronics,
NOW LOCALLY ASSEMBLED TO YOUR EXACT REQUIREMENTS
ex stock, no delays.



VERSATILE

- 1 to 19 buttons; 2, 4, 6 or 8 changeovers (16 by tandem).
- 4 button spacings; 10 mm., 15 mm., 17.5 mm. and 20 mm. pitch.
- 4 basic functions; push-push, interlatching, momentary, push-pull.
- 20 button styles plus illuminated (1 or 2 lamps).

LOW COST

Through design and automation at its best.

MINIATURISED

i.e. 5 buttons fit within 2" x 1" using 10 mm. pitch.

WIRING

Standard wiring techniques or wave soldering on PC Boards (or combination of both).

QUALITY

Silver laminate contacts, self-wiping.
Low contact resistance — low capacitance.
Sealed contacts impervious to solder flux or dust.
After 50,000 operations, a replacement contact shaft with new contacts can be quickly front inserted.

RATINGS

AC Modules 2 AMP @ 250 volts.
Standard DC Modules
1 AMP @ 28 volt DC,
0.45 AMP @ 115 volt AC.

Send for details and simple quotation/order chart and find out how you can revolutionize your designs with push button or piano key switches.

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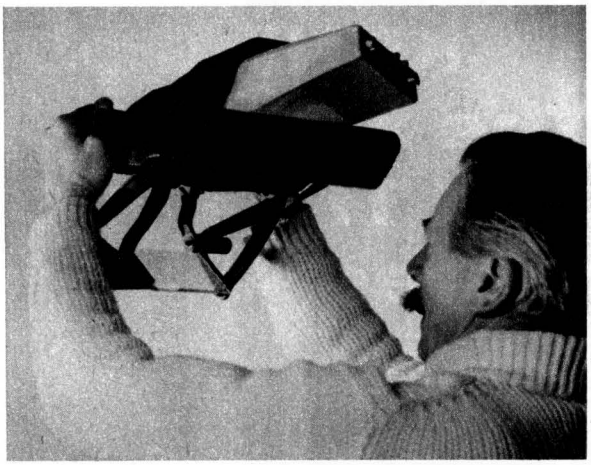
MCM2EA

True binocular head-up display



A true binocular head-up display manufactured by Elliott Flight Automation Ltd. in the U.K.

The system provides two identical groups of symbols (giving information on height, speed, altitude and course) and projects them from two parallel cathode ray tubes on to a wide, shallow reflector close to the pilot's eyes. (See "Electronics Australia," June, 1970, page 37.)

Copperclad cable

A new type of cable for domestic wiring use has been introduced in the U.K. by British Insulated Callender's Cables Ltd. Its main feature is the cable conductor which is of copper bonded to an aluminium core. Because it is cheaper and less subject to the wide price fluctuation of copper, it helps both to reduce and stabilise housing costs. Although looking much like ordinary wiring cable, and needing no special tools or fittings, the new cable is lighter and easier to handle than copper cable. To prove its reliability, BICC carried out an extensive series of tests which showed that the new cable compares favourably with copper in every respect. (British Insulated Callender's Cables Ltd., 21 Bloomsbury Street, London WC1, England.)

Asian telecom's network

A plan of operations for feasibility studies for the Asian telecommunications network was signed in Bangkok on April 17 by the Governments of the following 11 countries: Afghanistan, Cambodia, India, Indonesia, Iran, Laos, Malaysia, Nepal, Pakistan, Republic of Vietnam, and Singapore. Thailand was expected to sign within a week of the others. The International Telecommunication Union will carry out the feasibility studies, within the framework of the United Nations Development Program, to assist the Governments of the region in the development of national and international telecommunications links.

Low radioactive discharge

Westinghouse Electric Corporation, U.S.A., has developed a nuclear power plant design which eliminates nearly all discharge of radioactivity to the environment during normal operation. The new system enables nuclear power plant operators to concentrate and contain radioactivity within the reactor system itself for long periods of time. Radioactive gases may be contained within the system until stored on-site or shipped out. The new design completely eliminates the release of tritium, an isotype of hydrogen, from the plant during normal operation. Tritium, in the form of tritiated water, is confined within the system and need be processed for off-site disposal only once or twice during the approximate 40-year lifetime of a nuclear power plant.

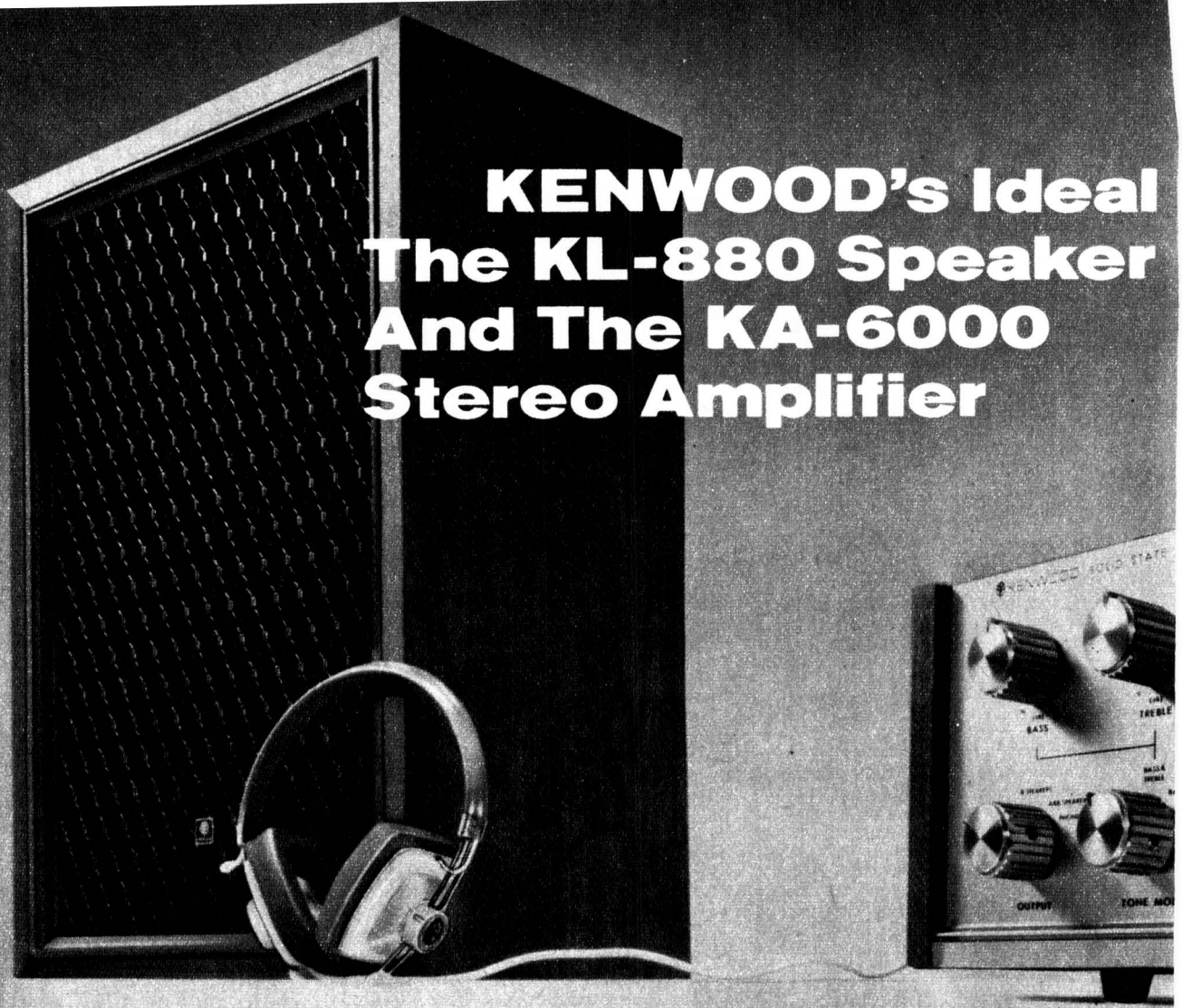
Video tape duplication

A new low-cost, high-speed process for the mass duplication of video tapes has been developed by Memorex Corporation in the U.S.A. Although no details have been supplied, the process appears to be a direct contact, print through method accompanied by the application of heat. The process is made possible by the properties of a new chromium dioxide tape which Memorex is now producing. Equipment in the company's laboratories simultaneously turns out multiple duplicates at high speed at an effective production rate 10 to 15 times faster than present processes. Existing video tape duplication uses a separate video tape recorder and takes one hour to duplicate a one-hour program. The Memorex thermal duplication process requires no electronic circuitry to transfer between the master and the copies. (Memorex Coporation, 1180 Shulman Avenue, Santa Clara, Calif. 95050, U.S.A.)

Indonesian contract

The Indonesian postal authorities have ordered equipment from Philips, Hilversum, Holland, to extend existing services. Modern transmitting and receiving equipment will be installed to maintain HF radio connections between Djakarta and Palembang, Medan, and Pontianak, and between Makassar and Menado. The order includes the training of Indonesian technicians and the installation of the equipment. Philips will also assist in expanding the telephone facilities at Medan, Sumatra. The existing Philips exchange will be given a capacity of 10,000 lines.

KENWOOD's Ideal The KL-880 Speaker And The KA-6000 Stereo Amplifier



SPEAKER SYSTEM
KL-880

HEAD PHONE
HS-3

Perfect performance mates—that's KENWOOD's KL-880 4-way, 5-speaker system and the KA-6000 stereo amplifier.
Sound as it really is—not as it almost is. That's an extra you get because the KL-880 has a 15-inch free-edge woofer, a 5-inch cone type midrange and horn type high midrange squawkers.
Add two horn type tweeters and KENWOOD provides you with amazing ultra-angle treble dispersion.

The KA-6000 is a power-packed 180-watt stereo amplifier that drives life into Hi-Fi speakers of lowest possible efficiency. Combined with the KL-880 they're an unbeatable stereo team.
There's wide power bandwidth of 10Hz to 50,000Hz with low-low IM distortion. And the KA-6000 has exclusive low level phono inputs for low level output phono cartridges of 2mV, 0.5mV or 0.05mV.
For personal, exclusive enjoyment there's

120-WATT SOLID STATE
STEREO AMPLIFIER **KA-4000**

* The wide power bandwidth of 13Hz to 30,000Hz with very low IM distortion.
* Lever type-20dB muting switch of quick response for momentary quiteness during telephone call, etc.
* Dimensions: 16-5/16"(W), 5-5/32"(H), 11-1/32"(H)

40-WATT
SOLID STATE STEREO AMPLIFIER
TK-150U

* 5 pairs of input terminals for MAG, AUX 1, AUX 2, TAPE REC and TAPE PLAY.
* Damping factor: 40 (at 16 ohms),
  20 (at 8 ohms)
* Dimensions: 10-1/4"(W), 4-1/8"(H), 9-3/8"(D)

60-WATT
SOLID STATE STEREO
AMPLIFIER
TK-250U

* 2 sets of stereo speaker terminals and front panel speaker selector switch.
* Dimensions: 13"(W), 4-1/8"(H), 9-15/16"(D)

Connection: System

180-WATT SOLID STATE STEREO AMPLIFIER KA-6000

the HS-3 headphone accessory.
So, put these KENWOOD giants together and add true stereo enjoyment to your life.
KENWOOD has a distinguished array of models operating with less power, but at top quality.

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30-WATT
FET SOLID STATE AM/FM STEREO RECEIVER TK-20U

* F.E.T. (Field Effect Transistor) 3-Gang Tuning Condenser frontend for superior sensitivity, image rejection and cross modulation ratio.
* Dimensions: 14-1/16"(W), 4-3/4"(H), 11-1/4"(D)

Ask for a catalogue or demonstration by your nearest dealer.

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Send me information on KENWOOD RECEIVERS, AMPLIFIERS, SPEAKERS & name of nearest KENWOOD retailer,

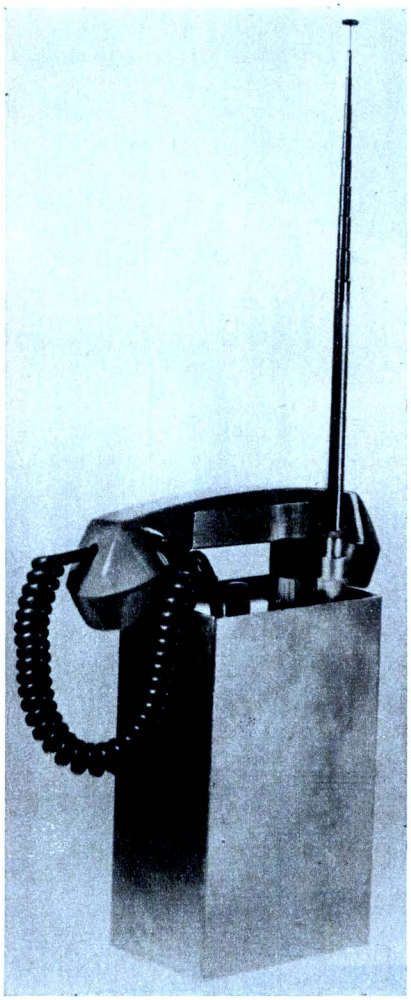
NAME: _____ AGE: _____

ADDRESS: _____

1-WATT HANDSET FOR THE 144MHz AMATEUR BAND

Following the description of our 52MHz Handset last month we present a modified version for operation in the 144MHz band. Constructed on the same printed circuit board, the circuit is basically the same as for the lower frequency model. This article should be read in conjunction with the two earlier issues.

By Alan Nutt



Identical in appearance to the 52MHz version, our Handset appears this month adapted for local 144MHz operation. The aerial may be either telescopic whip or solid rod.

The Handset described last month was aimed particularly at the amateur who wanted an easily transportable transceiver specifically for network operation. The frequency selected for the prototype was the local AM net channel of 53.866MHz.

On looking at a possible 144MHz version the choice of frequency is not so easily defined, particularly in the Sydney area where the only net frequency in operation at the present time is an FM group on 146MHz. There is apparently no well-defined AM net in operation on this band.

Accordingly, our choice of frequency has been a fairly arbitrary one, endeavouring to keep in mind local "gentlemen's agreements" and possible repeater or beacon frequencies. A figure of 144.5MHz has been chosen and, while in no way intending to influence development one way or the other, it may be suggested that this could perhaps form the basis of an AM network on this band, assuming it does not clash with already existing local arrangements.

As intimated, the circuitry is basically very similar to the 52MHz version, the only difference in function being the operation of the receiver HF oscillator which in this instance functions as an oscillator/doubler with an injection frequency of 133.8MHz into the mixer stage, Tr10.

All the RF tuned circuits are necessarily modified and some adjustment to component values has been made to optimise performance on this band, particularly in regard to input impedance matching in the transmitter PA stage and receiver oscillator injection level.

The supply leads in the transmitter use smaller value RF chokes, the self-capacitance of the pie-wound types becoming increasingly apparent at the higher operating frequencies. These chokes, in the collector supply of Tr1, 2 and 3 consist of 4 turns of 28 B &S enamel wire on FX1115 ferrite beads. All the other chokes marked with an asterisk, with the exception of the BLY33 collector choke are wound with six turns of the same wire on FX1115 beads.

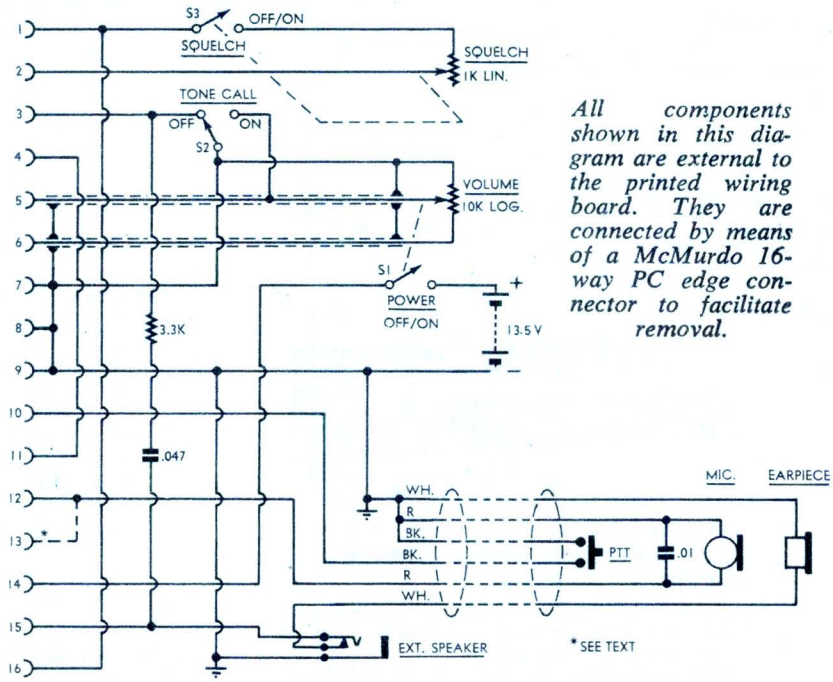
The PA collector choke consists of 15 turns of enamel wire, wound in the threads of a 5mm iron-dust core, Neosid grade 500.

There are no special construction points to be observed other than what has already been said in the earlier articles. However, a comment on the use of telescopic aerials may be relevant at this point.

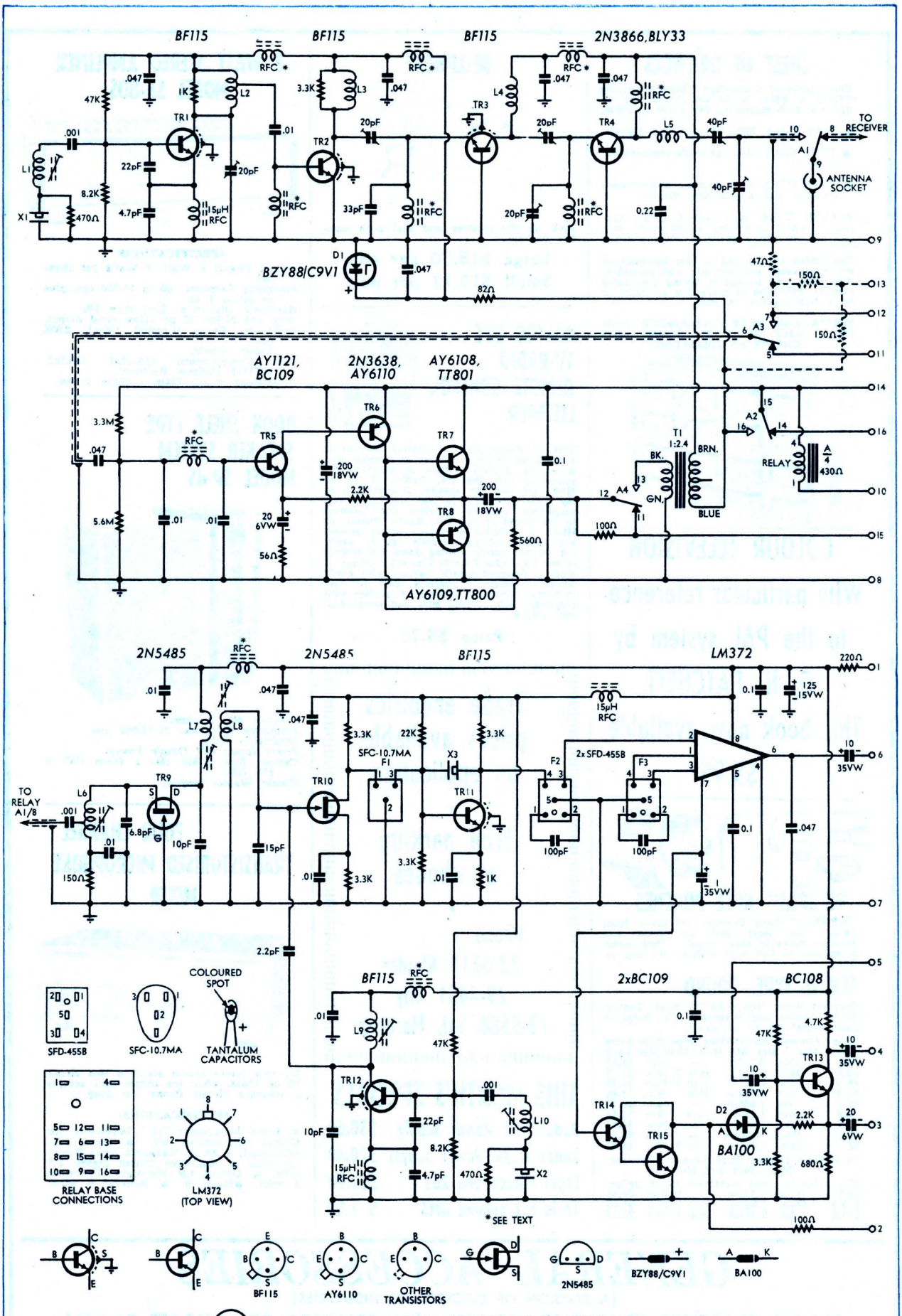
While, in fact, we used the same telescopic aerial for both versions of our transceiver during development, the length being suitably adjusted, we did have occasion to try a solid length of brass rod at one stage, just by way of comparison. The results were rather startling to say the least!

A comparative field strength check in our laboratory indicated an improvement of some 6dB in favour of the brass rod. We assumed, correctly as it turned out, that contact resistance in the sliding member of the telescopic aerial was the culprit. A good wash in cleaning solvent cured the problem and the performance on subsequent tests was identical. Which brings us to the point:

The entrance of dirt, grit and moisture into the body of a telescopic whip cannot be prevented easily. The very



All components shown in this diagram are external to the printed wiring board. They are connected by means of a McMurdo 16-way PC edge connector to facilitate removal.



144MHz HANDSET (FIXED FREQUENCY)

3/TC/6

CHEST OF DRAWERS

Three types of Galvanised Chests measuring 17⅛in x 6¾in x 11⅞in, containing 16 drawers, each measuring 6⅝ x 3¾in x 2⅛in.

- TYPE C.D.1. With 16 undivided drawers.
- TYPE C.D.2. With 16 triple compartment drawers.
- TYPE C.D.3. With 8 triple compartment drawers, and 8 undivided drawers.
- TYPE C.D.4. A 17⅛in x 11⅞in Galvanised Chest containing 4 full-length dawers each measuring 15¾in x 6⅝in x 2½in.

The Chests are finished in blue hammertone stoving enamel, are complete with identification cards and packed in strong corrugated cartons. Provision is made for all units to be bolted together in tiers.

WRITE FOR FREE CATALOGUE AND PRICE LIST OF TOOL BOXES AND CHESTS OF DRAWERS.

COLOUR TELEVISION

With particular reference to the PAL system by

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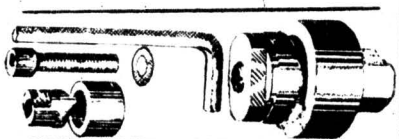


"PIPGRAS" HOLE PUNCHES

"PIPGRAS" Hole Punches are made from Alloy Tool Steel, and cut clean and accurate holes in sheet metal. They make a smooth, perfect hole without reaming or filing.

SCREW TYPE, ROUND

Supplied with "UNBRAKO" High Tensile Socket Screws and Wrenches. Cut holes in sheet metal up to 18 gauge.

Type No.	Nominal Size	Actual Size	Water Pipe Size (I.D.)	Pilot Drill Size	Price Each
32.S	⅛in	0.507in	—	¼in	$2.17
40.S	5/32in	0.618in	¼in	5/16in	$2.17
48.S	¾in	0.742in	⅜in	5/16in	$2.80
56.S	⅞in	0.884in	½in	⅝in	$3.86
64.S	1in	1.008in	—	⅝in	$4.10
72.S	1⅛in	1.133in	¾in	⅝in	$4.83
76.S	1 3/16in	1.172in	—	⅝in	$4.83
80.S	1¼in	1.258in	—	⅝in	$4.97
88.S	1⅜in	1.382in	1in	7/16in	$5.97

With Heat Treated, High Tensile Steel Hex. Head Bolt and Nut.

Cut holes in sheet metal up to 16 gauge.

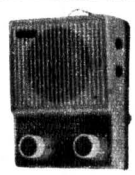
96.S	1½in	1.512in	—	9/16in	$6.68
112.S	1¾in	1.762in	1¼in	9/16in	$7.60
128.S	2in	2.014in	1½in	9/16in	$8.33

BELLPHONE

Pick up the receiver and dial push number desired.

Large $13.50 per pair
Small $10.12 per pair

KALTRO SVC TV-RADIO REMOTE CONTROL LISTENER



This TV-Radio Remote Control Listener is a combination of an extension speaker and a remote control station to regulate the sound of both the TV, Radio, Phono, or Hi-Fi set and the speaker incorporated in the Listener itself. In addition, up to two earphones can be attached for listening to the sound of the TV, Radio, Phono, or Hi-Fi set without disturbing others around you. Unwanted commercials can be easily cut off by merely turning down the control of the TV-Radio Remote Control Listener. A modern designed plastic cabinet with easily adjustable fingertip controls ideal for use in home, office and business. Complete with earphone, 20ft of lead wire and installation instructions.

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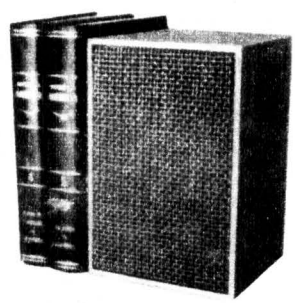
Radar 1XR Power Supply	$30.60
Radax 05XR Power Supply	$20.40
Lapel Microphone X67 ..	$00.90
Table Microphone BM3 ..	$ 7.50

8 WATT STEREO AMPLIFIER MODEL SA-80S

SPECIFICATIONS

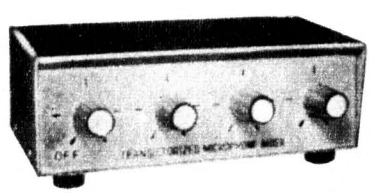
Output Power: 8 Watt, 4 Watts per channel.
Frequency Response: 60 to 15,000 cps. plus or minus 1 db.
Harmonic Distortion: Less than 3%.
Hum and Noise: 52 db below rated output.
Sensitivity: Phone (Crystal) 100mV 250K ohm.
Tuner 100mV.
Tube Complements: 12AX7x1, 30A5x2, 1S315x1 (Silicon Rectifier).
Dimensions: 5.1lb. 9¾in x 6¼in x 3in.

BOOK SHELF TYPE SPEAKER SYSTEM MODEL SP-4S



Speaker: 4in, 8 ohms.
Frequency Response: 70-13,000 cps.
Sensitivity: 93dB.
Power Input: 8W (Music Power).
Cabinet Size: 9⅞in (H) x 6¼in (W) x 5⅛ (D).
Finish: Walnut lacquer.

FOUR CHANNEL TRANSISTORISED MICROPHONE MIXER



All four inputs accept standard two circuit Phone Plugs, while the output jack accepts a standard circuit Phone Pin Plug.

SPECIFICATIONS:

● Input Impedance: "Hi" Impedance for Crystal Microphone, etc. ● Gain: Approximately 6 db. ● Maximum Input Signal: 1.5 volts. ● Maximum Output Signal: 2.5 volts. ● Output for Minimum Distortion: 2 volts. ●Hum: 0. ● Battery: 9 volts.

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nature of its construction and operation transfers any surface contamination to the interior where it is deposited on the inner surfaces and phosphor wiper contacts. It is not difficult to see that, over a relatively short period of time, contact resistance can build up to quite unacceptable levels, even at low frequencies.

In the light of this, we would suggest that if the use of a whip is contemplated on either band, it be thoroughly cleaned with solvent and wiped dry before use and that, after use, it be wiped clean before collapsing. Perhaps the better proposition, at least on the 2-metre band, is to use a solid length of rod or tube rather than run the risk of poor radiation due to contact deterioration.

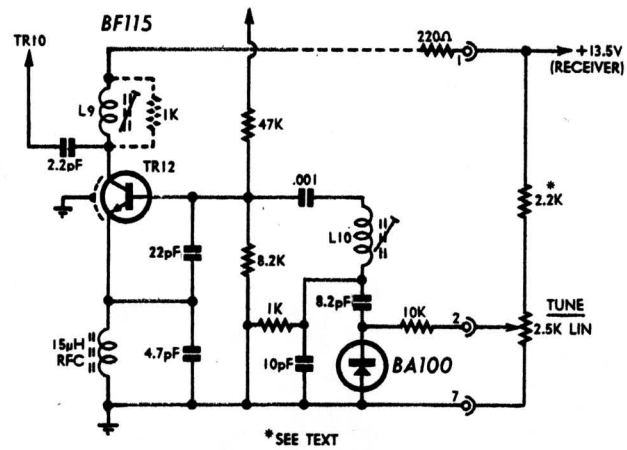
The components marked as optional in the parts list are required only if a carbon microphone is used, forming both the microphone supply and signal attenuation network. Similarly, if using a carbon microphone, the input line from the handset should be taken to terminal 13 on the connecting socket (shown dotted) and not to terminal 12 as shown.

Ideally, a wide-band oscilloscope and/or a VHF spectrum analyser would be used in final alignment of equipment of this type but, providing coil details and layout are fairly closely adhered to, quite satisfactory results can be obtained with a very limited amount of equipment.

Both transmitter and receiver alignment are straightforward and follow the same general pattern as the earlier design. Note, however, that the receiver HF oscillator collector load, L9, should be tuned to twice the crystal frequency for correct injection. With the constants chosen, it is not possible to select an incorrect harmonic and the slug in this coil may be peaked for maximum signal.

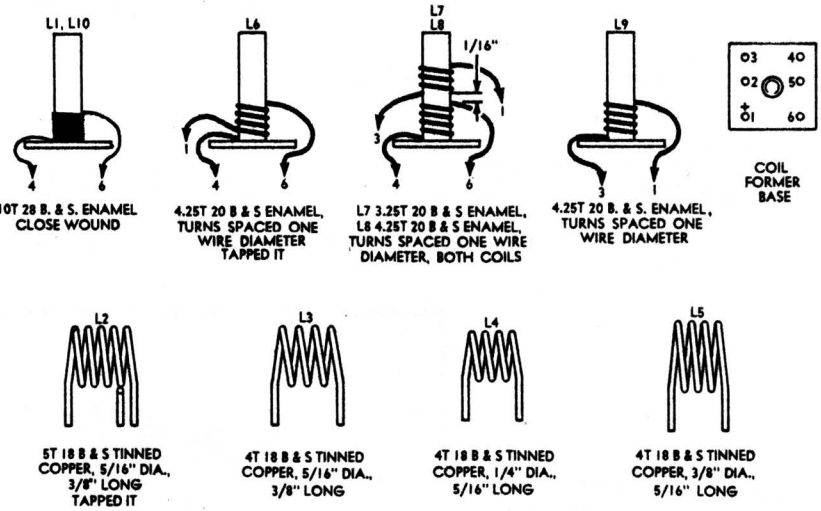
The remainder of the receiver RF circuits may be peaked for maximum signal from a generator or even a GDO if a suitable generator is not available. Generally, the alignment information given for the 52MHz version applies and may be referred to in the June issue.

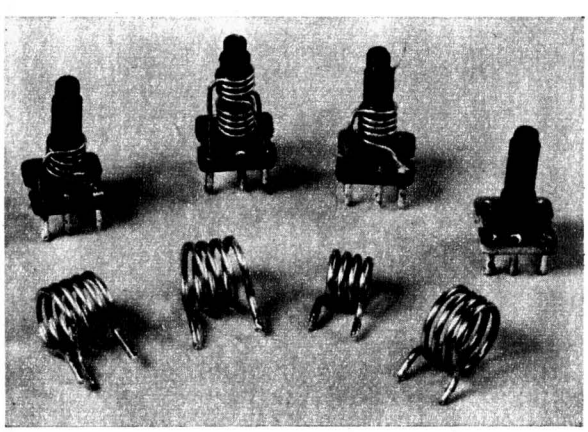
During the transmitter tuning procedure it is necessary to connect either a low level RF power meter or 50 ohm dummy load to the aerial socket. In the latter case a detector of the type described last month will be required to indicate relative output across the load resistor.



EA 144MHz HANDSET – RECEIVER VFO

The above diagram shows the modifications necessary for tunable operation of the receiver. The physical changes required are the same as for the 52MHz version described in the June issue.



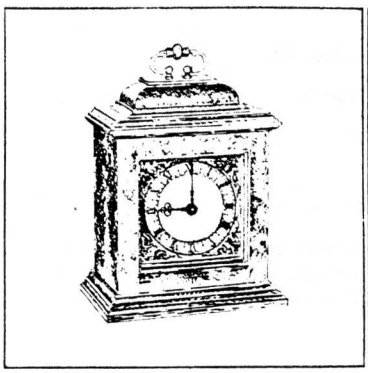


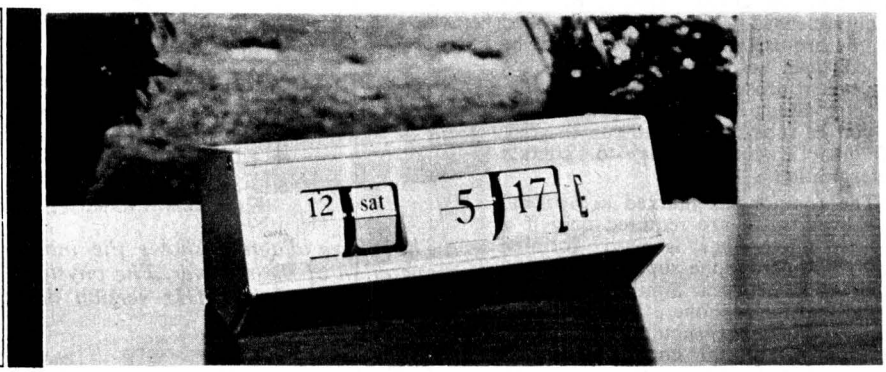
The above diagram and accompanying photo will assist in the construction of the coils for both transmitter and receiver. The ferrite slugs in the receiver coils should be held in position with either fine elastic, core-lock compound or thin strips of PVC sheet, otherwise vibration may affect tuning.

It should be possible to obtain at least 1 watt of output from the transmitter but, as we stressed last month, the criterion is not so much one of maximum output as optimum modulation linearity, as determined by a listening test.

All tuned circuits are initially peaked for maximum output but a final touch up of the PA stage input and output tuning will be required in order to achieve the best modulation quality. Frequency setting, where required, is by adjustment of the slug in L1.

As indicated in the development of





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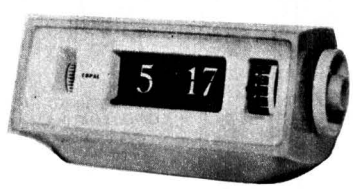
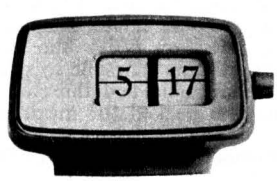
All Copal Caslon clocks are noise free and each model has a built-in neon lamp giving soft, diffused light so that you can see it even in the dark. Each model is available in 12-hour (readings 1.00 to 12.59) or 24-hour (readings 0.00 to 23.59) types.

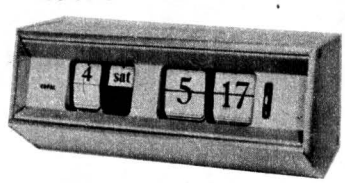


The Copal Caslon 701 alarm clock can be set to operate at intervals of 10 minutes up to 24 hours.



The Copal Caslon 201 desk/table clock 12 and 24 hour types. Range of attractive colours.

The Copal Caslon 401 wall clock 12 and 24 hour types. Large numerals.



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YOU WILL NEED THESE PARTS:

TRANSMITTER AND MODULATOR

3 BF115.
1 BLY33.
1 BC109.
1 2N3638 or AY6110.
1 TT801 or AY6108.
1 TT800 or AY6109.
1 15 ohm/84 ohm transformer (TRS215 or similar).
1 4-pole, double-throw relay (Varley VP4/CBB/21 or similar).
1 BZY88/C9V1 zener diode.
4 20pF trimmers (Philips 2222 808 00006).
2 40pF trimmers (Philips 2222 808 91503).
1 15uH peaking choke.
7 FX1115 or FX1242 ferrite beads (Mullard).
1 5mm coil form (Neosid 722/1 base, can and F29 slug).
1 miniature co-ax socket (Belling Lee L1465/FS/AG/NI).
1 5th overtone crystal (X1), half-carrier frequency (Hy-Q QC25 or Pye Q16).
1 iron dust slug (Neosid grade 500).

RESISTORS (all ¼W unless noted)

1 47 ohm (optional—see text).
1 56ohm.
1 82 ohm.
1 100 ohm.
2 150 ohm (optional—see text).
1 470 ohm.
1 560 ohm.
1 1,000 ohm ¼W.
1 2.2K.
1 3.3K ¼W.
1 8.2K.
1 47K.
1 3.3M.
1 5.6M.

CAPACITORS

1 4.7pF NPO.
1 22pF NPO.
1 33pF NPO.
1 1,000pF disc ceramic.
4 .01uF 25V disc.
6 .047uF 25V disc.
1 .1uF 25V disc.
1 .22uF 25V disc.
1 20uF 6V tantalum.
2 200uF 18V electrolytics.

RECEIVER

2 2N5485.
2 BF115.
2 BC109.
1 BC108.
1 National operational amplifier type LM372.
1 BA100 diode.
1 10.7MHz ceramic filter (Murata SFC-10.7MA).
2 455KHz ceramic filters (Murata SFD-455B).
4 5mm coil formers (Neosid 722/1, base can and F29 slug).
2 FX1115 or FX1242 ferrite beads (Mullard).
2 15uH peaking chokes.
1 10.245MHz crystal (X3), Hy-Q QC25 or Pye Q16.
1 5th overtone crystal (X2), Hy-Q QC25 or Pye Q16, $\frac{f(MHz)-10.7}{2}$

RESISTORS (all ¼W unless noted)

1 100 ohm.
1 150 ohm.
1 220 ohm.
1 470 ohm.
1 680 ohm.
1 1K ¼W.
1 2.2K.
4 3.3K.
2 3.3K ¼W.
1 4.7K.
1 8.2K ¼W.
1 22K ¼W.
1 47K.
1 47K ¼W.

CAPACITORS

1 2.2pF NPO.
1 4.7pF NPO.
1 6.8 pF NPO.
2 10pF NPO.
1 15 pF NPO.
1 22pF NPO.
2 100pF 100V styro or disc.
2 1,000pF disc.
5 .01uF 25V disc.
4 .047uF 25V disc.
3 .1uF 25V disc.
1 1uF 35V tantalum.
3 10uF 35V tantalum.
1 20uF 6V tantalum.
1 125uF 16V electrolytic.

ACCESSORIES

1 P/C board, 70/TX-1.
1 case, chassis, battery panel and carrying handle.
2 P/C boards for battery compartment.
3 springs.
3 battery holder tubes.
1 1K A taper potentiometer with SPST switch.
1 10K C taper potentiometer with SPST switch.
1 miniature SPDT toggle switch.
1 co-axial socket (SO-239).
1 co-axial plug (PL-259).
2 knobs.
1 handset assembly (Weston Electronics).
1 3.5mm phone jack, break contact.
1 miniature co-axial plug. (Belling Lee L1465/FP/AG/NI).
1 telescopic aerial, 20in minimum extended length.
1 3/8in grommet.
1 ¼in grommet.
1 3-lug tag strip.
1 16-way P/C edge connector, .15in contact spacing (McMurdo).
1 heat sink suit TO-5 case.
Hookup wire.
12in shielded wire.
16in small diameter coaxial cable, 50 ohm.
18 and 20 B & S TCu wire.
28 B & S enam. wire.
7 ¼in brass spacers, tapped ¼W.
Screws, nuts, PK screws, solder lugs.

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V70—A top performance high quality moving-magnet cartridge that out-performs many more expensive cartridges. Input sensitivity 5mV, Frequency response 20-20,000 Hz. Two models are available with replacement type diamond stylus. V70 with conical stylus—V70E with elliptical. When used with the NEAT G30 tone arm, an excellent low cost combination is obtained. Reviews from the "Gramophone" and "Electronics Australia" are available.

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Elega DR66C—8 ohm—25-17,000 Hz.	$17.50
Kaltro DH—025—8 ohm—20-12,000 Hz.	$7.50
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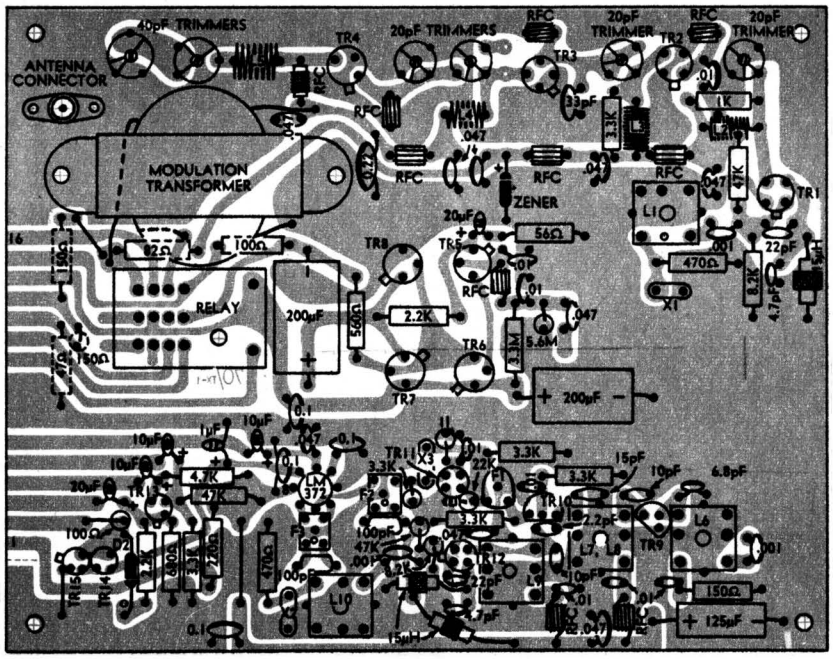
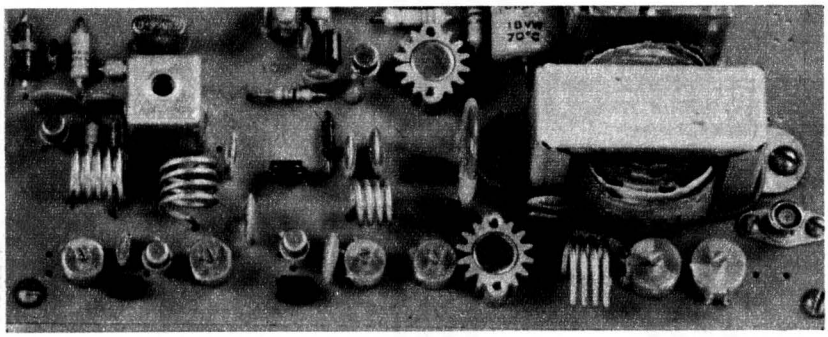


Use the above diagram in conjunction with the schematic on page 41 to assemble the components on to the wiring board. The ½W resistors are used where space limitations preclude the use of the larger ½W types in the receiver section. Observe carefully the polarity of all electrolytics.



The transmitter section of the board is shown above, indicating the position of the tank coils for each stage. As indicated earlier, heat sinks are not strictly necessary for the modulator transistors which operate well below their maximum ratings. The small disc capacitor alongside the trimmer in the lower centre of the photo is not used.

the 52MHz transceiver, only a small amount of modification permits the receiver to be tuned over a segment of the band which makes it more versatile than the fixed tuned version.

The changes are even simpler in this unit, involving only the replacement of the squelch components with the oscillator tuning circuitry. No change is required in L10 and, as before, it becomes the oscillator tuning inductance.

We chose to cover the more commonly used segment of the band from 144 to 146MHz although this may easily be modified by adjustment of the slug in L10 which is, in effect, the "bandset" control. The tuning range, in turn, may be adjusted over fairly wide limits by altering the value of the padding resistance in series with the "tuning" potentiometer.

Although we did not find it necessary, a resistor of 1K or so may be connected across the oscillator/doubler collector coil, L9, in order to broaden its response. This circuit is now required to tune the range 133.3 to 135.3 MHz, being twice the frequency covered by the tunable base-emitter circuitry. On test, our prototype exhibited little shift in injection level over the range when L9 was peaked about 134MHz.

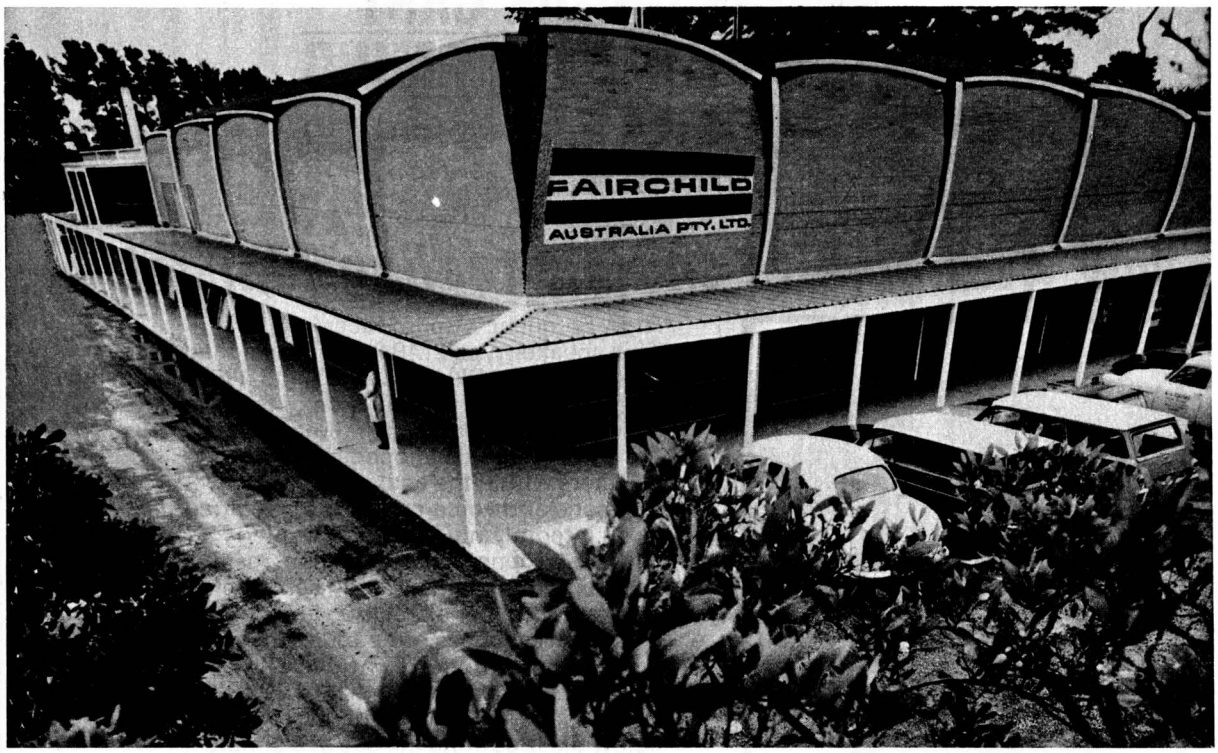
Peak L1 at the bottom or low frequency end of the tuning range, L7 in the centre and L8 at the top end.

This 2-metre transceiver has been a fairly logical extension of the 6-metre design and, while we make no extravagant claims as to its performance, it has proved very satisfactory for the purpose for which it was developed.

One final point, which should not need stressing but apparently is still a trap for even the oldest old-timer, concerns the batteries. If the equipment is to be out of action for even a short period of time, REMOVE THE BATTERIES. The small effort involved is well worth the time and trouble saved if the cells should leak over the other components! ■


Fairchild
Series
74

Fairchild is bursting at the seams



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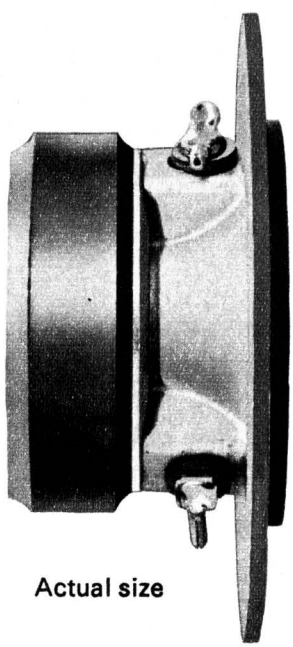

Actual size

High Frequency Reproducer.
This speaker type 2MBC/15 is designed to cover the range from 5kHz to 20kHz. Its diecast housing completely seals the rear side of the cone ensuring that there is no interaction with the air pressure developed by other speakers within the enclosure.
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SPECIFICATIONS

Type 54814/2MBC/15HF
Frequency Response 5-20kHz.
Voice Coil Impedance:—
15 ohms: recommended crossover capacitor 2mfds.
Min. Total Flux:— 16000 lines
Min. Flux Density:— 12600 Gauss
Voice Coil Dia.:— 9/16"
Mounting Hole Centres:— 3" centres x .20" dia.
Baffle Opening:— 2-1/4" dia.
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Extending the Range of a Sweep Generator

This article describes how to use a combination of a TV sweep generator and signal generator to perform "sweep alignment" of VHF equipment. The procedure for aligning the VHF converter featured in April is also described.

By Anthony Leo, VK2ZHK

In the April issue we described a two metre converter using metal oxide silicon field effect transistors (MOS FETs) in a design which gives low noise and has excellent cross-modulation characteristics. It also employs a system of double conversion, using only one crystal, to provide good image rejection.

This converter has a bandwidth of a little over 2MHz, providing coverage of the lower half of the band, 144 to 146MHz, or the upper half, 146 to 148MHz. Alternatively it can be used to cover the full 4MHz, but with some degradation in sensitivity and signal-to-noise ratio. It delivers an output signal from 3.5MHz to 7.5MHz.

With a 2MHz bandwidth, the first intermediate frequency (IF) band is from 38.625MHz to 40.625MHz, corresponding to 144MHz and 146MHz respectively. In all, there are nine tuned circuits, six at signal frequencies.

The alignment procedure given in the article was fairly simple, using either off-air signals or a VHF signal generator where possible. While the simple alignment procedures given in the article were satisfactory for the purposes of making the converter operational, they did not provide for optimum band pass shape.

In common with other converters and receivers designed to provide a specific band width, by means of circuits tuned to differing frequencies within the pass band, it is desirable — and in some cases essential — to use "sweep" techniques for alignment. Using a CRO and a sweep generator it is possible to display the band pass shape of an RF or IF amplifier and observe immediately the effect of adjusting various tuned circuits.

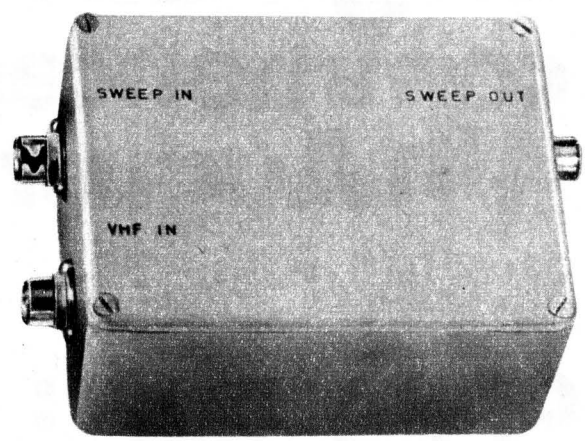
Although we have described a number of sweep generators, mainly for alignment of television IF strips, they have provided for direct sweep alignment only up to approximately 40MHz. Examples of these generators are those described in the March, 1961 and December, 1963 issues.

However, in conjunction with a second signal generator it is possible to use a sweep generator at considerably higher frequencies than those normally available. And, while the direct sweep alignment of the two metre converter at signal frequency is the subject of this article, the technique to be described is generally applicable to sweep alignment of most other VHF equipment.

Higher sweep frequencies can be produced by heterodyning the output of a sweep generator with that of a VHF signal generator to produce a sweep modulated VHF signal. The actual mixing of the two signals is carried out using a balanced ring mixer as shown in figure 1.

The mixer consists of two balanced transformers and a ring of diodes connected as shown. A VHF signal is fed into the primary of the first transformer, while the sweep signal is fed into the taps in the primary and secondary of the same transformer.

A VHF sweep signal is derived from the secondary of the second balanced transformer. Due to the balanced nature of the mixer the output signal consists of only two frequency products, the VHF input signal plus the HF sweep signal, and the VHF input minus the HF sweep signal.



The complete mixer unit is housed in a small cast aluminium box measuring approximately 4½in x 3½in x 2in (internal). The layout is not critical but complete shielding is recommended.

We constructed the modulator on a piece of "matrix" board which was then fitted in a diecast box as shown in the accompanying photograph. The two balanced transformers, which were wound on ferrite balun transformer cores, are mounted on the underside of the board. Co-axial sockets were used for input and output connections.

At least two readily available balun transformer cores are suitable for this application; the Ducon type F684 Q2 material, or the Neosid type 1050/1/F14.

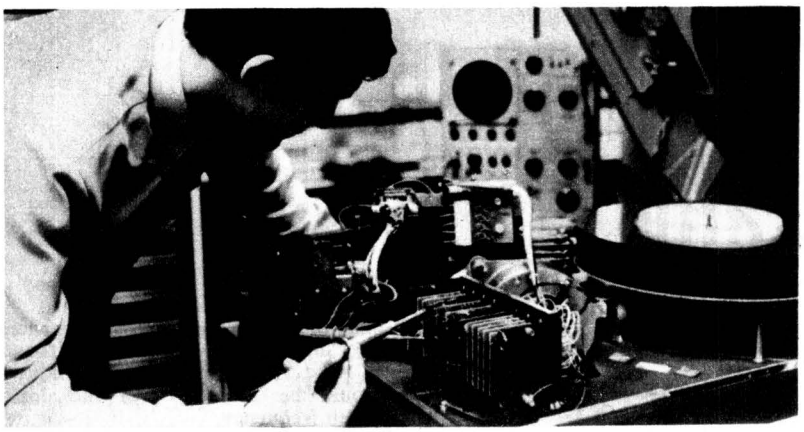
When using the modulator to sweep align the two metre converter there are a number of generator frequency combinations which can be used. In general, the sum of the VHF generator frequency and sweep generator frequency should be used to give the desired sweep frequency.

However, harmonics of either generator can also be used to obtain the required sweep frequency. Two examples of the VHF generator frequencies which can be used are 53MHz or 63MHz, assuming a sweep generator coverage between 38MHz and 42MHz. In the first example the second harmonic of the VHF generator (106MHz) is mixed with the sweep frequencies to give an output sweep between 144MHz and 148MHz. Note that the sweep width of the output is 4MHz.

However, if a VHF generator frequency of 63MHz is used then the second harmonic of the sweep frequencies, that is 76MHz to 84MHz, will beat with it to produce a sweep between 141MHz and 149MHz. Note that in using the second harmonic of the sweep frequencies, rather than the VHF generator, the effective sweep width of the output is doubled. When aligning the converter we used this latter method.

There are a number of requirements which should be satisfied when using this method of sweep alignment. Firstly the sweep generator should have an output level of sufficient magnitude to switch the diodes in the ring mixer. And, if a heterodyning frequency of 63MHz is used, the sweep generator should have a fairly high output level to ensure an adequate second harmonic level.

While the sweep generator should be set at a fairly high level, possibly maximum output with some generators, the actual output from the ring mixer should not be of such a level as to cause converter overload. To ensure that overload does not occur the oscilloscope should be set for maximum sensitivity or not less than 10mV/cm



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and the heterodyning generator should be set for minimum practicable output. The signal generator output level should be used to control the size of the oscilloscope display rather than altering sweep generator level or oscilloscope sensitivity. Overload in various stages of the converter can result in an erroneous response shape.

the converter will be the same as detailed in the April issue, we will repeat this procedure for the sake of continuity.

Set the slugs of all coils flush with the top of the wiring board, with the exception of the oscillator coil L1 — which should have the slug flush with the bottom of its former, near the

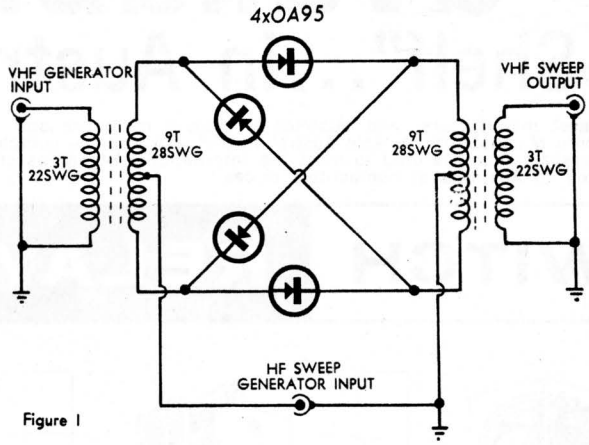

Figure 1

Figure 1. The circuit of the ring mixer. Only a few components are required and the balanced transformers are simple to wind. Details of the transformer cores are in the text.

As with all sweeping, it is necessary to demodulate the output signal from the converter before applying it to the oscilloscope input. A suitable circuit is shown in figure 2. This specific demodulator circuit is necessary in order to simulate the load of a receiver's input and preserve correct operation of the resonant circuit in the output stage of the converter.

When aligning the converter, the demodulator circuit may be wired between the converter and its output socket in the actual converter box. The demodulated signal can be then taken to the input of the oscilloscope using the normal coaxial output lead for the converter.

The equipment which we used to align the converter consisted of the following; the sweep generator described in March, 1961 and an Advance generator type E2 with a top frequency limit of 100MHz. A second VHF signal generator, Advance type D1/D, was used for the generation of marker pips which were injected directly as shown in figure 3. The marker generator provided an output directly between 144MHz and 146MHz.

In order to simplify sweep alignment the converter should be pre-aligned to a specific frequency using the marker signal generator and a receiver to monitor output. While the alignment of the oscillator and multiplier sections of

secondary winding. Set L2's tuning capacitor to about half mesh and similarly set L4's capacitor to about one third mesh.

Set L3's capacitor to about one eighth mesh and L5's capacitor to a little less. Now connect the converter to the supply voltage.

Using the lowest range of a multimeter to monitor the voltage across the 56 ohm emitter resistor of the AS305, adjust the oscillator slug (L1) for a peak. Now adjust L2's tuning capacitor for a small peak to about 0.6V, across the same resistor. The capacitor should be about half mesh.

Using the three-volt range of the multimeter to monitor the voltage across the source resistor (560 ohms) of

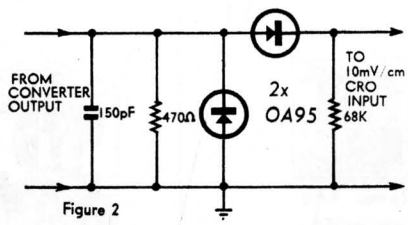

Figure 2

Figure 2. The demodulator. Although similar to most such circuits, this one has been designed to provide a correct load for the converter.

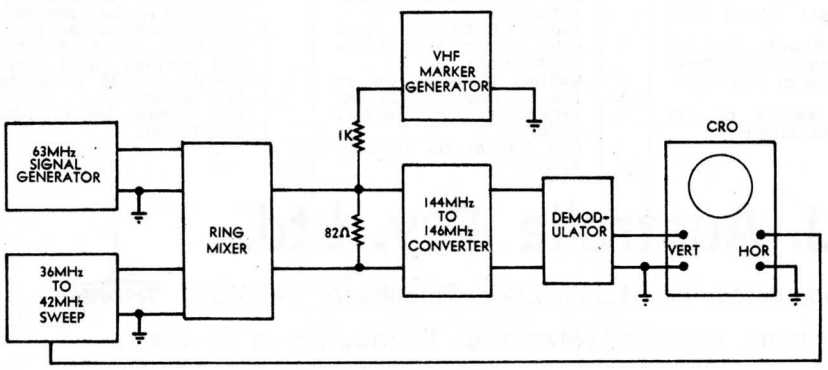

Figure 3

Figure 3. A block diagram of the complete sweep alignment set-up.

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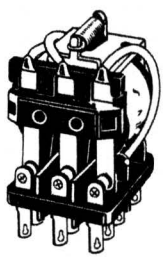

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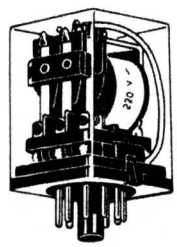

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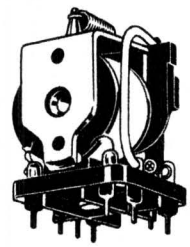

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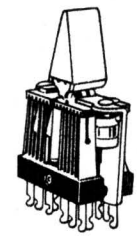

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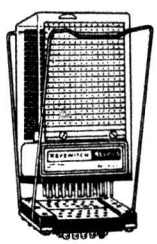

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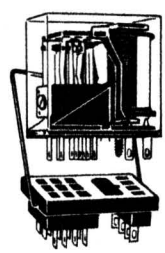

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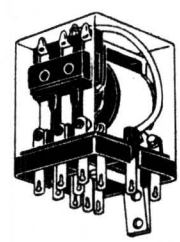

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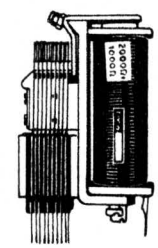

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the second mixer, wind the slug of L8 into the coil until the voltage dips to a minimum. Using the same meter range to monitor the voltage across the source resistor (560 ohms) of the first mixer, re-adjust L2's tuning capacitor for a dip to minimum voltage. Now re-adjust the oscillator slug for a voltage peak across the 56 ohm resistor.

The rest of the pre-alignment procedure consists of adjusting the various signal tuned circuits to peak at 145MHz. This can be done using the VHF generator and a receiver. Adjust the capacitors tuning L3, L4 and L5 for maximum output, also adjust the slugs of L6 and L7 for a peak at 145MHz.

Having pre-aligned the converter, it should be set up for sweep alignment as shown in figure 3. A signal generator set at 63MHz (or 53MHz) is connected to the ring modulator and adjusted for an output level of about five millivolts. The sweep generator also connected to the modulator should be set for maximum output, with deviation and fine tuning adjusted for an appropriate amount of sweep between 36MHz and 42MHz. The timebase output from the sweep generator is connected to the horizontal amplifier of the oscilloscope in the usual way.

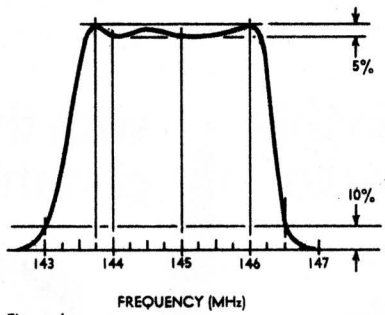


Figure 4

Figure 4. The bandpass achieved on the original converter.

The output from the modulator should be terminated across an 82 ohm resistor as shown. Marker pips can be injected across the terminating resistor via a 1K resistor. A marker generator output level of about ten millivolts should be adequate for reasonable size marker pips. However, it is wise to use lowest practicable level from both the marker and signal generators.

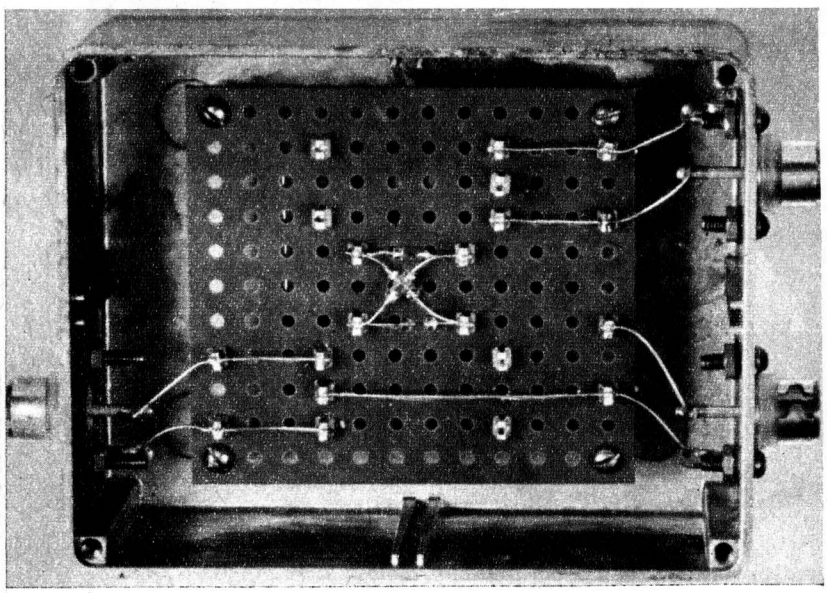
Output from the converter is then fed to the oscilloscope via the demodulator circuit shown in figure 2. The band shape of the converter after pre-alignment will peak sharply at 145MHz with a slight bump at about 143.75.

Using a plastic tool, wind the slug of L6 out of the coil and observe that a second peak will develop toward the high frequency end of the bandshape display. This peak should be set to 146MHz. Next, adjust the 20pF capacitor tuning L4 for an increase in capacity which will result in a third peak developing at about 144.5MHz. The overall symmetry of the bandshape and the depth of the troughs may be optimised by adjusting the slug in L7. Lastly, any tilt of the top of the response may be corrected by slight adjustments in the filter coil L8.

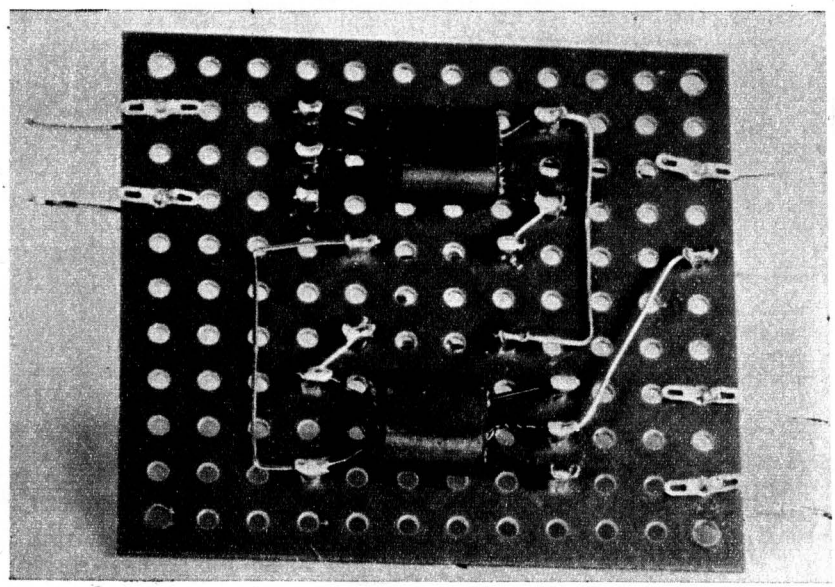
The other tuned circuits in the converter can be adjusted slightly for optimum response shape. However, when adjusting the tuned circuits it should be done in a systematic and careful way. The haphazard adjustment of slugs and capacitors should not be resorted to as this will invariably lead to trouble and frustration. It may be helpful to write down the tuning effects of various adjustments.

If, when sweep aligning, a point is reached where the alignment seems hopeless it is often a good idea to start from scratch by re-peaking all circuits to the same frequency. In the case of the converter, readjust all tuned circuits to 145MHz. It may be necessary to make several attempts at the alignment in order to practise and gain the "feel" of things.

The desired bandshape is shown in figure 4. Note that the lower corner of the bandshape is at approximately 143.75MHz due to the resonance of the RFC and 3.9pF capacitor at the converter's output. The upper corner occurs at 146MHz and is determined by the adjustment of L6. A small peak will occur a little below 145MHz as a result of the adjustment of L7 and the capacitor tuning L4.



The ring mixer is assembled on a piece of matrix board, this being supported on spacers in the metal box. The network of four diodes is visible in the centre.



The underside of the matrix board showing the two balanced transformers wound on ferrite balun transformer cores.

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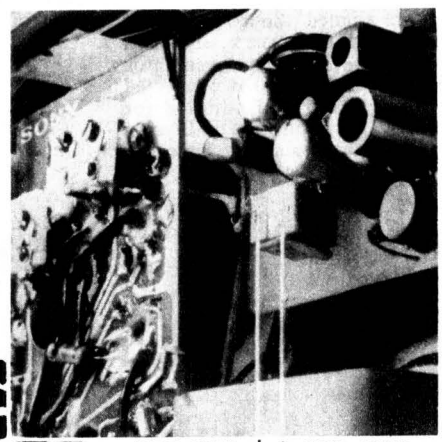

BFB-455A ⌟ ⌞ SFD-455B

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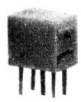

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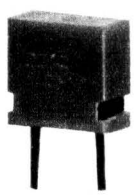
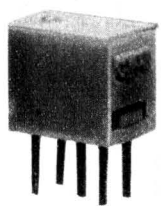


MODEL BFB-455A improves the selectivity of transistor radios when used as an emitter by-pass in transistor IF Stages.



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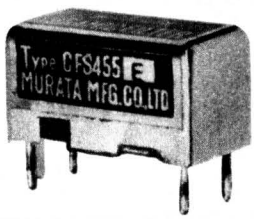

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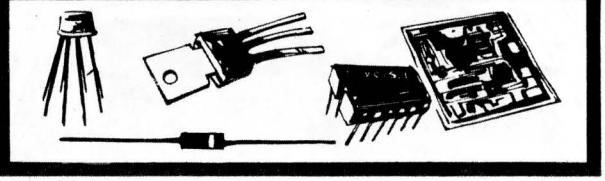

Chapter 14

by Jamieson Rowe

The PNPN thyristor structure — its behaviour — internal regeneration — current vs. gain, and the choice of silicon — methods of triggering — breakover, and the Shockley diode — gate triggering and the SCR — light triggering and the LASCR — related devices — bidirectional thyristors — device ratings — dv/dt and di/dt — applications.

The semiconductor devices which we have examined in the preceding chapters are all based on crystalline structures having either one, or at most two P-N junctions. We may now turn to consider a further important group of devices, based on a slightly more complex structure in which there are three main P-N junctions: the group of devices known as **thyristors.**

There are quite a large number of devices grouped under the designation "thyristors," and superficially some of these devices may seem very different. Despite this, virtually all thyristor devices are based upon a common fundamental three-junction structure, fabricated from silicon material. In its basic form, this structure has the PNPN configuration shown in figure 14.1(a).

Probably the most important characteristic of this structure is that it possesses the ability to operate in two stable conduction states. In one of these states, called the "off" or **blocking** state, it passes only saturation and leakage current, behaving in a very similar fashion to a reverse biased P-N junction. Conversely in the second state, called the "on" or **conducting** state, it is capable of passing very heavy current, its behaviour in this case being very similar to that of a forward-biased P-N junction.

Besides being able to operate in these two states, the PNPN structure is capable of switching extremely rapidly from the blocking state to the conducting state. This makes it very suitable for use as a power switching element, and also makes the structure a solid state equivalent of the older gas-filled thyratron switching tube. It was recognition of this equivalence which provided the rationale behind the term "thyristor."

As will be explained shortly, there are a variety of methods whereby the basic thyristor PNPN structure may be triggered into switching from the blocking to the conducting state. And although most thyristor devices are capable of being triggered by more than one of these possible methods, the majority of device types are designed to permit efficient and reliable triggering by one particular method. Hence it is broadly true that the wide variety of thyristor devices differ from one another mainly in terms of the provision made for triggering.

The basic operation of the PNPN thyristor structure may be understood by reference to figure 14.1. As shown in (a), the structure is normally connected so that the P-type end is connected to the positive polarity of the supply, becoming the device "anode," while the N-type end is connected to the negative supply polarity and becomes the "cathode." The load is connected in series with the device and the supply, usually in the anode lead.

It may be seen that this connection has the result that the outer P-N junctions, marked "1" and "3", are potentially forward-biased, but the centre junction "2" is reverse-biased. Hence because this reverse-biased central junction is in series with the other two, one would expect the device as a whole to behave in a very similar fashion to a reverse-biased diode. And this is precisely the way the structure does behave if the supply voltage Vf is slowly increased from zero to a moderate level. Only saturation and leakage currents flow, the magnitude of these being very small due to the silicon material involved. Fairly obviously, this corresponds to the "blocking" conduction state of the PNPN structure.

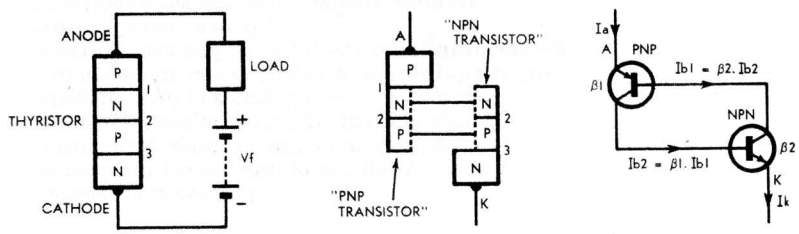

Figure 14.1 (a) (b) (c)

The conditions present within the structure in the alternative "on" state are perhaps less obvious. However, they may be visualised fairly readily by examining the mechanisms involved when the structure is triggered into switching from blocking into heavy conduction. Although a variety of possible methods exist whereby this switching may be triggered, as noted earlier, there are actually only two basic switching mechanisms involved.

One of these mechanisms involves an internal regeneration or positive feedback loop present in the PNPN thyristor structure.

Like the two junctions of a bipolar transistor, the three junctions of the PNPN thyristor structure are capable of interacting in such a way that the mechanisms of injection, diffusion and collection can produce current amplification. However, the presence of the additional P-N junction and the configuration of the resulting PNPN structure both have the additional effect that this amplification action is not only increased, but is also effectively formed into a continuous internal positive feedback loop.

This may be readily understood if the PNPN structure is visualised as effectively consisting of a PNP-NPN bipolar transistor combination, sharing a common collector-base junction such that the base region of each device is the collector region of the other. That this analysis is a valid one may be seen from figure 14.1(b), where the two "hidden transistors" within the PNPN structure have been separated.

As may be seen, the "PNP" transistor is effectively formed from the three upper regions of the PNPN structure, involving junctions 1 and 2, while the "NPN" transistor is effectively formed from the three lower regions and involves junctions 2 and 3. Junction 2 thus forms the collector-base junction of both devices.

A brief examination of the diagram should reveal that, because of the PNPN configuration, the "input" current of each of the two constituent transistors is formed by the "output" current of the other. Thus the collector current of the PNP device forms the base current of the NPN device, while the collector current of the latter in turn forms the base current of the former. This is demonstrated in the schematic diagram of figure 14.1(c).

From this it may be seen that the two transistors are effectively connected in a regenerative and potentially unstable feedback loop. Any current passed by one will tend to be amplified by the other, then passed back to the first to be amplified again, and so on, the device current tending to rise rapidly and without obvious limit.

One might thus expect that immediately following the application of supply voltage to the PNPN structure,

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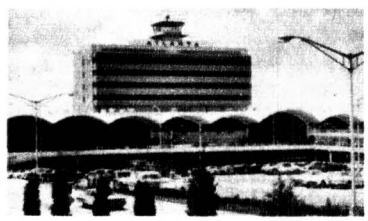

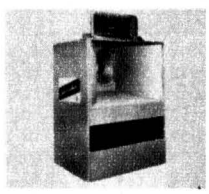

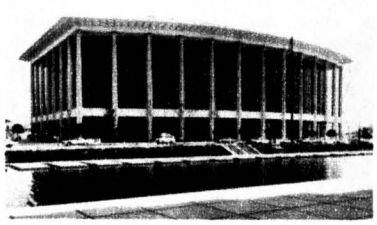

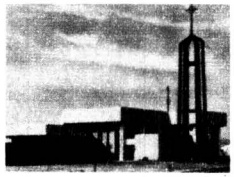

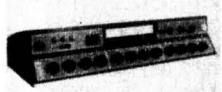

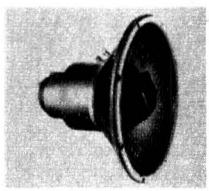

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it would regeneratively amplify its own saturation and leakage currents in this fashion, and rapidly draw the maximum current possible from the supply.

To understand why such spontaneous amplification of saturation and leakage currents does not occur, it is necessary to consider the second basic mechanism involved in thyristor operation. This mechanism is associated not with the PNPN configuration of the device structure, but rather with the deliberate use of silicon as the semiconductor material rather than any other.

It may be recalled from chapter 11 that the current gain of a silicon bipolar transistor falls away at low current levels, primarily due to the effect of carrier recombination at so-called "recombination centres" in the emitter depletion layer. Thus like any other silicon bipolar transistors, the transistors constituting the PNPN thyristor structure tend to exhibit lower and lower amplification at reducing current levels.

As explained in chapter 11, the fall in current gain of normal silicon bipolar transistors at low current levels tends to be rather an embarrassment, as it limits the effective input resistance and gain of the device in typical amplifier applications. And, for this reason, silicon transistor manufacturers have directed considerable effort toward reducing the effect with these devices.

However with thyristor devices the effect is actually exploited, because it provides a means whereby the PNPN structure is able to remain stably in the low-current blocking state until intentionally triggered. By maintaining the gain of both the internal transistors of the PNPN structure below unity at the current level corresponding to the saturation and leakage currents, it thus prevents regeneration and current increase.

This should explain why thyristor devices are made almost exclusively from silicon semiconductor material. With other materials, such as germanium, not only is the fall-off in gain at low current levels somewhat less rapid than with silicon, but at the same time the saturation and leakage current levels tend to be somewhat higher at normal operating temperatures. Both these differences tend to make it very much harder to prevent a PNPN structure from spontaneously regenerating, so that thyristor devices made from these materials tend to be impractical.

It is the very low gain of the internal transistors at the low saturation and leakage current levels, then, which prevents the silicon PNPN structure of a thyristor device from regenerating, and allows it to remain stably in the blocking state. How then, the reader may well be asking, is the device triggered into regenerating and switching into its high conduction state?

This is achieved quite simply, by causing a brief intentional increase in the current passing through any one or more of the three device junctions. Provided that this increase is sufficient to raise the product of the current gains of the two internal transistors above unity, regeneration will then occur and the device will consequently drive itself rapidly into the heavy conduction state. Once this regeneration process begins, the initial cause of the triggering current increase may be removed without effect, because the regeneration process is self-maintaining once having been initiated.

In switching itself to the conduction state, the PNPN structure draws a rapidly increasing current, while at the same time its voltage drop falls sharply. In a typical switching circuit such as that of figure 14.1(a), this process ceases only when the current reaches a value where the two internal transistors of the thyristor enter saturation. When this occurs the regenerative action again ceases, because it may be remembered that saturation of a bipolar transistor involves a rapid drop in current gain.

Having entered the heavy conduction state, a thyristor thus remains stably in this state. Its voltage drop is basically that of the two internal transistors in saturation, being typically between 0.7V and 2.5V. The current level flowing through the device from anode to cathode (conventional current flow) is thus limited almost entirely by the supply voltage Vf and the load resistance of the load.

As the switching of a thyristor may be triggered by temporarily increasing the current through any one or more of the three device junctions, this makes it possible to trigger the device in a number of ways. As noted earlier, it is the consequent variety of possible triggering methods which has in fact resulted in the wide number of different thyristor devices in present use.

One possible way of triggering a device is simply to increase the effective anode-cathode voltage applied to the device, either steadily or with a short pulse superimposed upon the supply. By raising the anode-cathode voltage to the point where leakage current itself reaches the level required to raise the internal gain product above unity, regeneration is initiated as before.

Although this method of triggering may be used with almost all thyristor devices, it is virtually the only triggering method possible with one particular device. This is the **Shockley diode**, so named to commemorate its prediction from theory by physicist William Shockley. The first actual device was developed in mid-1956 by researchers Moll, Tannenbaum, Goldey and Holonyak of Bell Laboratories. Other names sometimes used for the Shockley diode are "PNPN diode," "four-layer diode," and "breakover diode."

As may be seen from figure 14.2 (a) where a simple diagram of a Shockley diode is shown together with its alternative schematic symbols, this device is basically identical with the elementary PNPN device shown in figure 14.1. It is thus the simplest of the thyristor device "family."

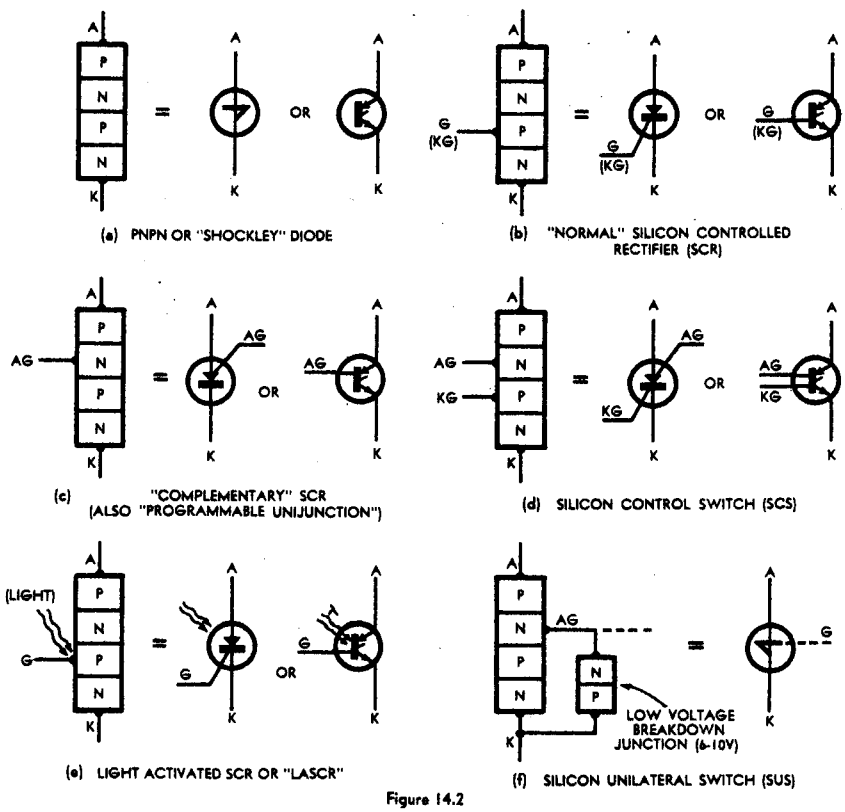

Figure 14.2

The characteristic of a typical Shockley diode is shown in figure 14.3 (a). It may be seen that upon application of forward voltage Vf the device remains initially in the low current blocking state. However if Vf is increased to the "breakover voltage" Vbo of the device, regeneration occurs and the device rapidly drops back through the unstable negative resistance switching region to reach the high current conduction (saturation) region.

The device will remain in the high current region unless, or until its current is forced by the external circuit conditions to drop below a certain "holding current," shown on the diagram as Ih. While in the high current region the device characteristic closely approximates that of a normal forward-biased P-N diode. When reverse-biased the device also behaves in a manner which closely approximates a P-N diode with reverse bias, the current remaining very low until one or both of the reverse-biased "outer" junctions enters avalanche breakdown.

A second possible way of triggering the basic PNPN structure of a thyristor is by injecting additional current carriers into either of the semiconductor

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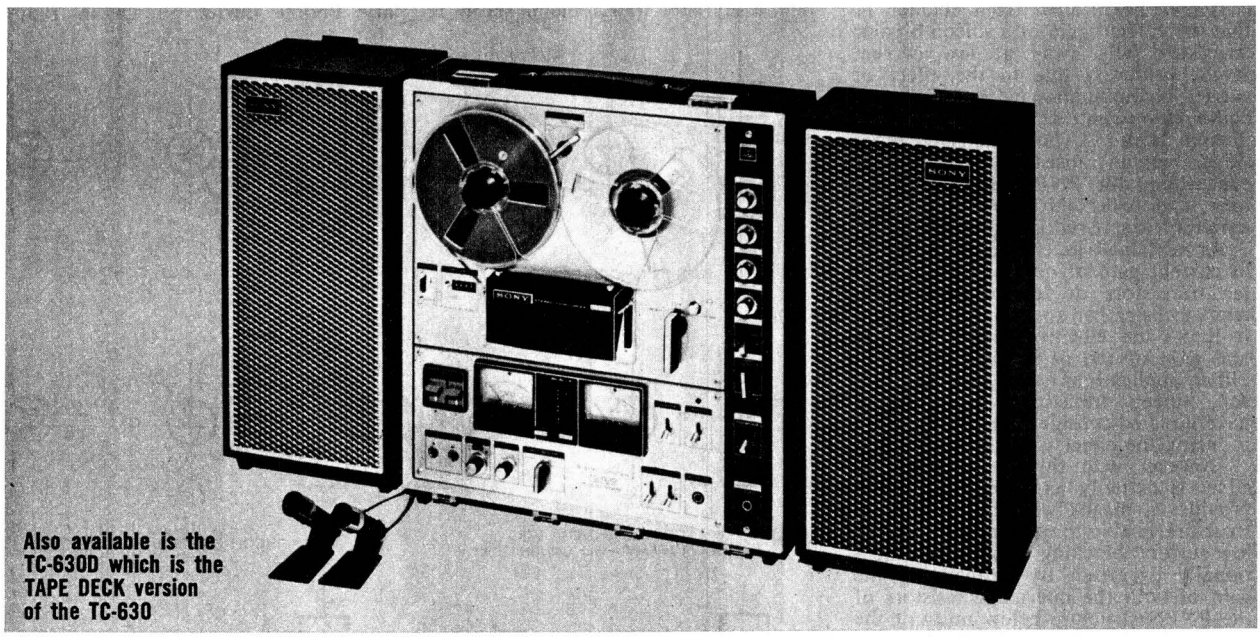

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regions adjacent to the central P-N junction. This has the effect of supplying base current to one or other of the two internal transistors, resulting as before in the rise in device current levels necessary for the gain to rise and initiate regeneration.

Thyristor devices designed especially to be triggered in this way are provided with a third electrode connected to one or other of the two central semiconductor regions, to permit convenient injection of carriers. This electrode is generally referred to as a "gate," being alternatively designated a **cathode gate** when associated with the central P-type region, or an **anode gate** when associated with the central N-type region.

This type of device has become known as a **Silicon Controlled Rectifier,** or "SCR," although controlled rectification of AC forms only one of its many applications. The first SCR device was developed in 1957 by Gordon Hall, a semiconductor device engineer working at the General Electric rectifier plant in Clyde, N.Y.

Because it has been found easier to fabricate high power SCR devices in the configuration designed for triggering from a cathode gate electrode, as shown in figure 14.2 (b), this configuration has become known as the "normal" SCR configuration. Accordingly the alternative type of device having an anode gate has become known as a "complementary" SCR, as shown in 14.2 (c).

Low power devices having the same basic configuration as that of figure 14.2 (c) are also called **programmable unijunctions.** This term is used because they may be arranged quite easily, in a suitable circuit configuration, to perform the functions of an adjustable-parameter unijunction. Actually low power SCRs of both the "normal" and "complementary" configurations may be used in this fashion.

The characteristic of a typical SCR device is shown in figure 14.3(b). As may be seen, for the zero gate current case (Ig=0) it is basically identical with the characteristic of the Shockley diode shown in (a). However, in this case the switching or breakover voltage may be reduced from the value Vbo, by the injection of gate current. Increasing values of gate current Ig1, Ig2, Ig3 and Ig4 thus result in the reduction of breakover voltage to values Vb1, Vb2, Vb3 and Vb4 respectively.

In passing it should perhaps be noted that to trigger the PNPN structure by means of a cathode gate, a forward bias is applied between this electrode and the cathode, whereas triggering by means of an anode gate is achieved by application of forward bias between this electrode and the anode.

As one might perhaps expect, it is possible to construct a thyristor device having both an "anode gate" and a "cathode gate" — in other words, a device with gate electrodes connected to both the internal N-type and P-type regions of the PNPN structure. Such devices are made, being given the name **Silicon Controlled Switch** or "SCS."

Although generally only capable of operating at relatively modest power levels, SCS devices find many applications because of the flexibility offered by the two gate electrodes. The schematic symbols used for SCS devices are shown in figure 14.2(d), while the characteristic is very similar to that of the SCR shown in figure 14.3(b).

It may be noted that in the foregoing discussion of SCR and SCS devices, no mention has been made of any mechanism whereby the gate electrode(s) may be used to switch a device "off." The reason for this is that with most SCR and SCS devices the gate electrode(s) is functionally almost identical with the grid electrode of a gas-filled thyratron valve, being capable of initiating device turn-on, but incapable of producing turn-off once the device is conducting. Thus in normal use they are turned off by arranging for the anode-cathode voltage to drop below the value which produces the "holding current" Ih shown in figure 14.3(b).

By the adoption of special device geometries, by careful control of doping levels and by considerably reducing the current densities reached within the devices, manufacturers have in fact been able to produce thyristor devices capable of being turned off by a large reverse bias applied to a gate electrode. These have usually been called **Gate Turnoff Switches** (GTO) or **Gate Controlled Switches** (GCS). However, devices of this type have not become widely used, mainly because their function can generally be duplicated more economically using a silicon bipolar switching transistor.

A third available method of triggering the PNPN structure of a thyristor is to increase the excitation energy of the crystal lattice, by the application of additional light or heat. This has the effect of increasing the generation of "intrinsic" electron-hole carrier pairs, and thus results in an increase in the device saturation currents. Naturally this mechanism is again capable of initiating device turn-on, providing the current levels are increased to the level required for regeneration to take place.

Although relatively few applications would appear to exist for a thyristor device triggered by long-wavelength heat energy, a significant number of applications have been found for a device capable of being triggered by infra-red and visible radiation. Device manufacturers have accordingly been motivated to produce devices capable of being triggered by this type of radiation.

Generally such devices employ the basic PNPN thyristor configuration but with a modified, "flat" geometry designed to allow improved penetration of the semiconductor die by the triggering radiation. The case or package in which the device is encapsulated is provided with a "window" covered with mica, glass or a suitably transparent plastic material.

While it would be feasible to produce a diode device of this type, most light-triggered thyristors are in fact provided with at least one normal gate electrode. This is provided to allow electrical control of the radiation sensitivity of the device. Thus practical light-triggered thyristors are either of the **Light-Activated SCR** (LASCR) variety, having a single gate electrode as illustrated in figure 14.2(e), or of the **Light-Activated SCS** (LASCS) variety with two gate electrodes.

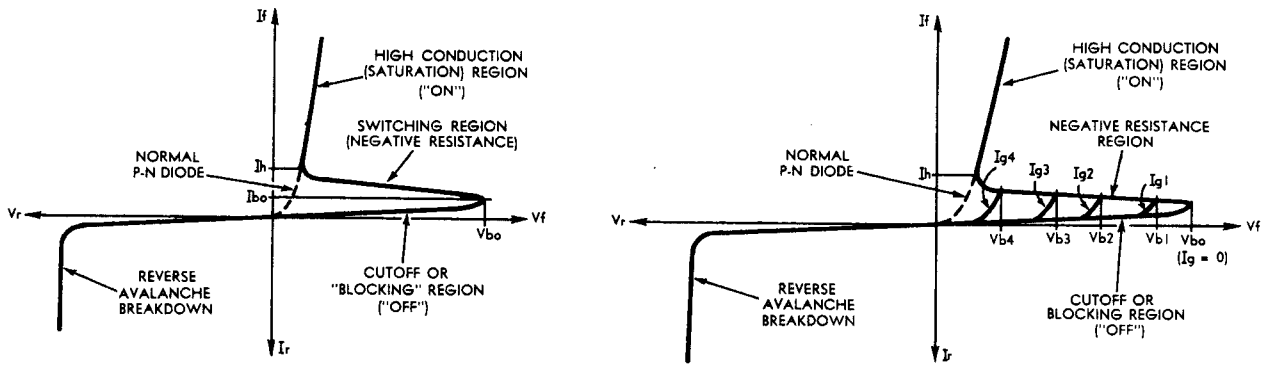

Figure 14.3 (a) PNPN DIODE CHARACTERISTIC (b) SCR CHARACTERISTIC

In addition to the thyristor devices which are designed to be triggered by one of the three basic methods just described, there have appeared a number of devices designed to be triggered in more complex ways. One such device is the **Silicon Unilateral Switch** or SUS, whose basic structure and schematic symbol are illustrated in figure 14.2(f).

As may be seen, this device is basically a complementary SCR with an inbuilt breakdown or "zener" diode junction connected between anode gate and cathode. The idea behind this is that the PNPN structure is triggered into conduction only when the voltage applied to the device exceeds that necessary to produce breakdown in the auxiliary junction. As the breakdown voltage of this junction can be quite accurately controlled, and made as low as 6-10V, the SUS can thus be used as a close-tolerance low voltage equivalent of the Shockley diode.

It may be noted that all of the thyristor devices described in the foregoing are **unidirectional** — i.e., their thyristor action applies for only one polarity of the applied anode-cathode voltage. This means that if such devices are to be used in applications where thyristor action is required for both supply polarities, as in AC circuits, it is generally necessary to use

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2N277	3.77	2N3646	0.90	AS307	0.81	AY8114	4.72	OA91	0.33
2N278	4.32	2N3691	0.85	AS308	0.81	AY8115	2.25	OA95	0.39
2N301	2.66	2N3692	0.90	AS310	0.81	AY8116	1.80	OA202	0.75
2N301-A	3.84	2N3693	0.86	AS311	0.77	AY8117	9.15	OA670	1.68
2N384	2.88	2N3694	0.90	AS312	0.77	AY8135	5.40	OA675	0.60
2N388A	2.36	2N3702	1.01	AS313	0.81	AZ069	0.51	OC20	6.38
2N394A	2.13	2N3703	0.96	ASY73	2.12	BA100	0.44	OC22	3.03
2N404	1.50	2N3704	1.77	ASY76	2.10	BA102	1.46	OC23	3.80
2N404-A	1.74	2N3705	1.73	ASY77	1.83	BA114	0.39	OC24	3.45
2N406	1.01	2N3706	1.65	ASY80	1.68	BA122	0.53	OC44N	1.11
2N417	1.77	2N3707	1.14	ASZ15	2.81	BC107	0.83	OC45N	1.11
2N441	3.08	2N3731	3.17	ASZ16	3.03	BC108	0.76	OC74	0.96
2N443	3.51	2N3819	1.77	ASZ17	2.60	BC109	0.91	2-OC74N	1.92
2N456A	4.20	2N3826	1.68	ASZ18	2.91	BC147	0.76	OC75N	1.49
2N458A	6.12	2N3827	1.74	ASZ20	0.98	BC148	0.68	OC140	1.95
2N489B	14.76	2N4036	2.01	ASZ21	2.16	BC149	0.79	OC141	2.60
2N591	1.05	2N4121	1.04	AT316	0.68	BC157	0.89	OC201	3.78
2N649	2.12	2N4250	1.17	AT318	0.68	BC158	0.76	OC202	3.68
2N657	4.79	2N4354	1.28	AT319	0.69	BC159	0.89	OC915	2.21
2N696	1.13	2N4355	1.65	AT321	0.69	BC177	0.91	SD55	0.63
2N697	1.17	2N4356	1.65	AT322	0.63	BC178	0.84	SE1001	1.13
2N706A	1.08	2N4360	1.58	AT323	0.68	BC179	0.92	SE1002	1.20
2N929	1.50	2SB474	3.30	AT324	0.68	BC186	0.79	SE1010	1.80
2N930	1.80	3N140	2.55	AT325	0.83	BCY10	2.59	SE2001	0.98
2N1038	3.92	3N141	2.34	AT331	1.02	BCY11	3.24	SE2002	1.20
2N1046	17.94	AB1101	1.20	AT337	0.75	BCY12	3.14	SE3030 (AY8112)	6.75
2N1073B	11.60	AB1102	0.87	AT338	1.50	BCY39	5.19	SE3031 (AY8112)	6.75
2N1100	7.23	AB1136	0.54	AT341	0.69	BCY71	2.05	SE3032 (AY8113)	6.75
2N1132	2.25	AC107	2.28	AT350	1.14	BCZ10	1.95	SE3033 (AY8114)	4.72
2N1302	1.01	AC125	0.96	AT355	0.98	BCZ11	2.37	SE3035 (AY8114)	4.72
2N1303	1.01	AC126	0.96	AT356	0.75	BCZ12	2.16	SE4001	1.05
2N1304	1.13	AC127	1.16	AT1138	2.66	BDY20	3.51	SE4002	1.13
2N1305	1.13	AC127/128	2.21	AT1138A	3.84	BDY38	2.59	SE4010	1.20
2N1306	1.32	AC127/132	2.16	AX1101	1.53	BF115	87c	SE5001	2.10
2N1307	1.32	AC128	1.05	AX1103	1.70	BF145	64c	SE5002	2.10
2N1308	1.64	2AC128	2.10	AX1104	1.86	BF167	1.08	SE5003	2.48
2N1309	1.64	AC132	1.05	AX1107	1.37	BF173	1.15	SE5020	4.05
2N1540	4.08	AC172	1.20	AX1108	1.86	BF177	1.63	SE5023	3.15
2N1546	5.96	AC187	1.20	AX1127	1.50	BF178	1.80	SE5025	1.35
2N1563	5.45	AC187/188	2.36	AX1130	1.50	BF179	2.04	SE6001	0.75
2N1639	1.02	AC188	1.16	AX1131	1.70	BF180	1.80	SE6002	0.90
2N1671-A	5.16	2AC188	2.31	AX1132	1.50	BF184	0.72	SE7001	4.05
2N1671-B	5.73	AD139	2.52	AX1142	1.20	BF185	0.72	SE7002	3.60
2N1908	24.47	2-AD139	5.04	AX1143	1.58	BF194	0.67	SE7010	4.05
2N2101	2.55	AD149	2.45	AX1144	1.44	BF200	1.32	SE7020	5.40
2N2147	2.24	2-AD149	4.89	AX1166	1.37	BFY51	5.19	SE8001	4.05
2N2148	1.68	AD161/162	4.32	AX1284	1.41	BSX19	2.16	SE8002	4.50
2N2188	2.79	AD4004	0.63	AX1285	1.28	BSY11	8.43	ST2	1.47
2N2189	3.57	AF114N	1.08	AX1298	1.37	BY126/200	0.48	T1C31	4.44
2N2270	2.64	AF115N	1.08	AX1304	1.44	BY126/400	0.56	T1C44	1.68
2N2613	1.83	AF116N	0.93	AX1305	1.49	BY126/500	0.63	T1C45	1.92
2N2646	2.19	AF117N	0.93	AY1101	0.68	BY127/800	0.78	TIC46	2.03
2N2996	3.15	AF118	2.52	AY1102	1.04	BZX70 Series	1.95		
2N3005	5.32	AF185	2.40	AY1103	1.35	BZY88 C3V3 to C11	0.83	T1C47	2.27
2N3053	2.48	AF186	4.46	AY1104	1.35	BZY88 C12 to C30	0.98	T1S37	2.36
2N3054	2.63	AN1101	0.60	AY1106	1.65	BZY94 (Obsolete)	0.98	T1S43	2.36
2N3055	2.63	AN1102	0.68	AY1110	1.50	BZY95 Series	2.16	T1S68 Pair	17.40
2N3525	3.17	AN1103	0.60	AY1112	0.69	BZY96 Series	2.16	TIS88	2.63
2N3563	0.90	AN1104	0.60	AY1113	0.69	BZZ14 to 29	2.37	40250	1.78
2N3564	1.08	AN1105	0.60	AY1114	0.60	C106Y1	2.10	40360	2.48
2N3565	0.86	AN2001	0.45	AY1115	0.60	D13-T1	1.95	40361	2.49
2N3566	1.01	AN2004	0.60	AY1116	0.68	MB05	1.88	40362	2.69
2N3567	1.08	AN7102	0.90	AY1117	0.68	MB1	2.03	40406	1.80
2N3568	1.08	AN7105	0.68	AY1119	0.60	MB3	2.65	40407	1.31
2N3569	1.23	AS43	0.65	AY1120	0.98	MB6	3.39	40408	2.36
2N3638	0.90	AS147	0.66	AY1121	0.98	MJE2955	4.55	40409	1.59
2N3638-A	1.13	AS148	0.63	AY6108	1.65	MJE3055	3.06	40410	1.65
2N3641	1.13	AS149	0.68	AY6109	1.65	OA5	0.65	40411	6.36
2N3642	1.26	AS208	1.25	AY8108 (AY8103)	3.75				

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either two devices in inverse parallel, or a single device in conjunction with some type of rectifier circuit.

Happily such circuit complication may be obviated in at least some AC applications, because there exists a further group of thyristor devices which are in fact capable of **bidirectional** operation. Three of these devices are in common use, one being a bidirectional diode device, another a bidirectional triode, and the third a symmetrical version of the SUS device. All three may be regarded as developments from the basic PNPN structure of figure 14.1.

The bidirectional diode thyristor consists of a modified PNPN structure which behaves as if it consisted of two Shockley diodes connected in inverse parallel. Thus for either polarity of applied voltage it behaves as a reverse-biased junction until its breakover voltage Vbo is reached, whereupon it regenerates and conducts as before.

The first device of this type was developed by the Hunt Electronics Corporation of Dallas, Texas, in the early 1960s. Currently a device of this type is marketed by the STC-ITT organisation under the name "Sidac." The basic structure of a typical device is shown in figure 14.4(a), together with the alternative schematic symbols, while the characteristic is represented by the heavy curve in 14.4(c).

The bidirectional triode thyristor or **Triac** device is similar to the diode device, but represents a further modification of the basic PNPN structure to allow triggering in both directions by means of a single gate electrode. Its behaviour is thus very similar to that of two SCR devices connected in inverse parallel.

The Triac was developed by General Electric in 1964. As may be seen from figure 14.4(b), its internal configuration is relatively complex. Because of this it tends to be rather difficult to produce.

The single gate electrode of the Triac controls its breakover for both polarities of the applied voltage. The control action is very similar to that of an SCR gate, with increasing gate current levels corresponding to reduced breakover voltages. This is illustrated by the dashed curve segments on the characteristic of figure 14.4(c).

The third type of bidirectional thyristor device in current use is the **Silicon Bilateral Switch** (SBS). This is again a General Electric development, being essentially an inverse parallel combination of two SUS devices of the type shown in figure 14.2(f). Hence by analogy with the relationship between the SUS and the Shockley diode, the SBS forms a close-tolerance low voltage equivalent of the bidirectional diode thyristor.

Although brief, the foregoing survey includes practically all of the thyristor devices in significant use at the time of writing this chapter. However, mention should perhaps be made in passing of a further device which — although not strictly a thyristor at all — is often included for convenience in the thyristor device "family."

This device is the **Diac,** which is a bidirectional breakover or trigger diode frequently used for triggering the Triac. Developed by General Electric, the Diac behaves in a rather similar fashion to the bidirectional diode thyristor; it switches into conduction when an applied voltage of either polarity exceeds about 30V. However the device is not a thyristor, being in reality a three-layer PNP structure rather like a symmetrical bipolar transistor without a base electrode. Its operation involves a relatively straightforward mechanism of amplified avalanche breakdown.

Like the basic performance parameters and ratings of the other semiconductor devices examined in previous chapters, those of thyristor devices are to a large extent controllable by manipulation of doping levels and device geometry. Thus it is possible to fabricate thyristors having breakover voltages falling over a very wide range, from as low as a few volts for some SUS and SBS devices to as high as 10,000V for specialised high-power SCR devices.

Current and power ratings are similarly controllable over a very wide range. Some very low power SCS and programmable unijunction devices are rated for operation at current levels in the order of a few tens of milliamps, while heavy-duty SCR devices intended for such applications as electric traction control circuitry may have current ratings as high as 1,600 amps.

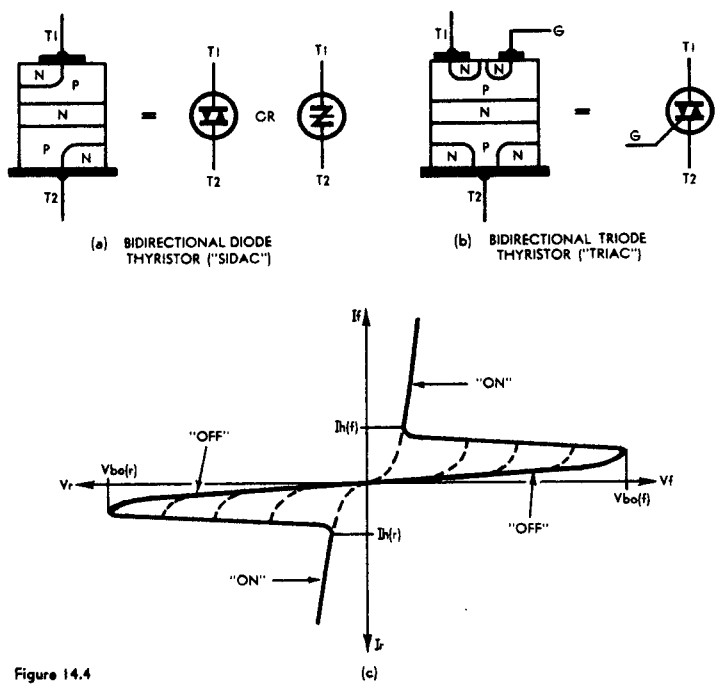

Figure 14.4

Apart from voltage and current ratings, however, there are two further ratings which play an important part in determining the suitability of a thyristor device for a given application. These ratings are rather unique to thyristor devices, both being concerned with the rates of change of voltage and current.

One of the ratings defines a maximum rate of change of the supply voltage applied to a thyristor device. This is known as the **dv/dt rating.**

The reason for the dv/dt rating is that any thyristor can be triggered into conduction from the forward blocking state, at a supply voltage far below its breakover voltage Vbo, if that supply voltage is applied sufficiently rapidly. This is the so-called **rate effect,** which is due to the fact that in the forward blocking state the reverse biased central junction of the PNPN structure has significant depletion capacitance.

In effect, this capacitance provides yet another mechanism whereby a thyristor may be triggered. Like any other capacitance, it tends to draw a reactive current proportional to the rate of change of applied voltage. Hence if the supply voltage is applied to the thyristor sufficiently rapidly, this reactive current will reach a value sufficient to initiate regeneration.

In a few thyristor devices, the rate effect is actually used as a means of triggering; an example is the "Sidac" bidirectional diode, which is usually triggered by a fast-risetime pulse superimposed on the AC supply. However, in most cases thyristors are intended to be triggered by one of the methods discussed earlier, and thus precautions must be taken to ensure that spurious additional triggering does not occur due to rate effect.

From this it may be evident that the dv/dt rating of a thyristor is equally important whether rate effect triggering is to be avoided, or to be exploited. If rate effect triggering must be avoided, then the dv/dt rating indicates the maximum allowable rate of change of applied voltage. Conversely if the device is to be triggered by this means, then the dv/dt rating represents the rate of change which must be adequately exceeded by the intended trigger pulse for reliable triggering.

The dv/dt rating of thyristor devices may be controlled by manipulation of the doping levels and geometry, and hence practical devices have dv/dt ratings which vary over a wide range to suit the intended applications.

The second of the unique thyristor device ratings defines the maximum allowable rate at which the current drawn by the device may be permitted to increase when the device is triggered from the blocking state into conduction. This is known as the inrush current rate, or **di/dt rating.**

The reason for the di/dt rating is that no practical thyristor device is

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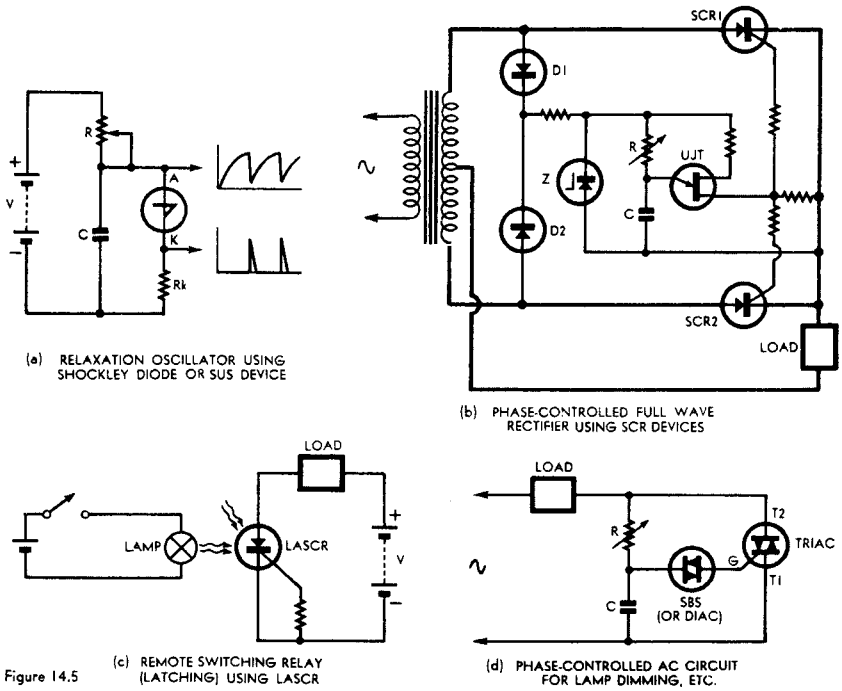

(a) RELAXATION OSCILLATOR USING SHOCKLEY DIODE OR SUS DEVICE

(b) PHASE-CONTROLLED FULL WAVE RECTIFIER USING SCR DEVICES

(c) REMOTE SWITCHING RELAY (LATCHING) USING LASCR

(d) PHASE-CONTROLLED AC CIRCUIT FOR LAMP DIMMING, ETC.

Figure 14.5

capable of switching from the blocking to the fully conducting state instantaneously. A finite time is required for the new charge conditions appropriate to the fully conducting state to distribute over the device junctions.

When anode-cathode current initially begins to flow, it is localised in a relatively small area of the junctions. In the case of a device triggered by means of a cathode or anode gate, the current is initially localised in the area of the junctions adjacent to the gate contact, because of the bulk resistance of the various semiconductor regions. A short "spreading" time is required before the current distributes itself evenly over the full area of the device junctions.

Because of the initial current localisation, the maximum current which may be safely withstood by a thyristor device immediately after triggering tends to be only a fraction of its full rated current capacity. Only as the current distributes over the full area of the device junctions does the current level, corresponding to the threshold of overheating and damage, rise sufficiently to allow the device to accept its full rated current.

To prevent the device from being damaged, then, it is necessary to arrange that the circuitry associated with the thyristor limits the rate of increase or "inrush" of conduction current so that this does not exceed the rate at which the device junctions "turn on." And this is the significance of the di/dt rating specified by the thyristor device manufacturer.

Typical "standard" thyristor devices have di/dt ratings falling between about 30 and 200 amps/microsecond. However, high power SCR devices with di/dt ratings as high as 600 amps/microsecond have recently been developed by National Electronics Inc., of Illinois. These devices employ a special "regenerative gate" triggering mechanism, whereby the initial localisation of current in the device is itself arranged to promote current distribution and rapid turn-on.

In the remaining short space available in this discussion of thyristor devices, a brief survey will be given of some of the more common applications of the devices.

Because of its characteristic, the Shockley diode makes an almost ideal voltage-sensitive switching element. So too does the SUS device, which provides essentially the same characteristics at somewhat lower voltage levels. Both devices thus find use in many types of switching and pulse circuitry.

A common application is in simple R-C relaxation oscillator circuits, used for sawtooth wave and pulse generation. A simple circuit of this type is shown for illustration in figure 14.5(a), where it may be seen that the thyristor element performs a function identical with that of the unijunction of figure 7.9, or the familiar neon lamp.

Probably one of the most common applications of SCR devices is in controlled rectifier circuits, for which their gate-triggered facility makes them very well suited. In this respect the SCR forms a worthy successor to earlier discharge devices such as the hydrogen thyratron and the ignitron.

The diagram of figure 14.5 (b) illustrates a full-wave controlled rectifier circuit using two SCR devices (SCR1, SCR2). The conduction of the SCRs is controlled in this type of circuit by adjustment of the phase of the triggering pulses fed to the device gates. Hence by retarding the triggering pulses to a point relatively late in each half-cycle, the SCRs are arranged to conduct for only a small portion of the full half-cycle, and the DC load current is relatively small. Conversely, by advancing the triggering pulses to a point early in each half-cycle, the SCRs are allowed to conduct for a greater proportion of the time, and accordingly the DC load current is increased.

In the circuit shown the phase-control is achieved by deriving the SCR triggering pulses from a relaxation oscillator employing a unijunction transistor (UJT). The supply for the oscillator is derived from the AC supply across the transformer secondary, being full-wave rectified by diodes D1 and D2, and clipped to a suitable level by zener diode Z.

Because there is no filtering in the oscillator supply, its operation is synchronised with the AC supply. Hence at the beginning of each supply half-cycle, capacitor C begins to charge up to the firing point of the unijunction. By varying resistor R, the time taken to reach the unijunction firing point may be adjusted between a point very early in the half-cycle and a point very late. Hence R becomes the control which determines SCR triggering phase and average DC load current.

A simple but very useful application of light-triggered devices such as the LASCR is in remote switching relay applications, as illustrated in figure 14.5(c). Here the combination of a lamp and the LASCR essentially behaves in the same manner as a conventional electro-magnetic relay, offering complete isolation between control and load circuits. In addition the combination offers considerably improved reliability, increased operating speed and freedom from contact bounce.

If a DC supply is used in the load circuit, as shown, the relay is self-latching because the LASCR remains in the conduction state even if the lamp is subsequently extinguished after being lit. However if a non-latching relay is required, this can be achieved simply by employing an AC or unfiltered rectifier supply in place of the DC load supply.

Bidirectional devices such as the Triac, Sidac and SBS are very attractive for AC power control applications, their characteristics allowing considerable circuit simplification compared with other devices. This is well illustrated by the circuit of figure 14.5(d).

As may be seen, the use of a Triac device together with an SBS or Diac for triggering allows the circuit to be reduced to a bare assembly of four components. Together with the two semiconductors there is only the charging capacitor C and the variable resistor R used to vary the triggering phase. This provides a complete low-cost lamp dimming circuit which, in domestic applications, may be fitted if necessary into the wall cavity formerly occupied by the conventional flush switch.

SUGGESTED FURTHER READING

CLEARY, J. F., (Ed.) **General Electric Transistor Manual,** 7th Edition, 1964. General Electric Company, Syracuse, New York.

GUTZWILLER, F. W., (Ed.) **SCR Manual,** 4th Edition, 1967. Semiconductor Products Department, General Electric Company, Syracuse, New York.

HEY, J. C., "The Widening World of the SCR," in **Electronics,** V.37, No. 25, September 21, 1964.

ROWE, J., "The Regenerative Gate SCR," in **Electronics Australia,** V.30. No. 11, February 1969.

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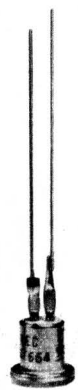
SCRs — MAXIMUM RATINGS — 30 Amp RMS

STANDARD ITEM	Symbol	2SF 32A	2SF 34A	2SF 36A	2SF 38A	2SF 210A	2SF 211A	2SF 727	2SF 728	2SF 729	Unit
HIGHSPEED ITEM		— —	2SF 762 2SF 762A	2SF 763 2SF 763A	2SF 764 2SF 764A	2SF 765 2SF 765A	2SF 766 2SF 766A	— —	— —	— —	— —
*Non Rep. P.R.V.	V_{Rsurge}	150	300	400	500	600	720	1000	1200	1500	V
*Rep. P.R.V.	V_{RM}	100	200	300	400	500	600	800	1000	1200	V
*Rep. P.F.V.	V_{FOM}	100	200	300	400	500	600	800	1000	1200	V
Avg. Rect. Current	I_O	10 (T_a = 50°C FN12 H. Sink									A
		19 (T_c = 45°C), 30 Ar.m.s.									

SCRs — MAXIMUM RATINGS — 17 Amp RMS

STANDARD ITEM	Symbol	2SF 22	2SF 24	2SF 26	2SF 28	2SF 205	2SF 206	2SF 717	2SF 718	2SF 719	Unit
HIGHSPEED ITEM		— —	2SF 752 2SF 752A	2SF 753 2SF 753A	2SF 754 2SF 754A	2SF 755 2SF 755A	2SF 756 2SF 756A	— —	— —	— —	— —
*Non Rep. P.R.V.	V_{Rsurge}	150	300	400	500	600	720	1000	1200	1500	V
*Non Rep. P.R.V.	V_{RM}	100	200	300	400	500	600	800	1000	1200	V
*Rep. P.F.V.	V_{FOM}	100	200	300	400	500	600	800	1000	1200	V
Avg. Rect. Current	I_O	5.0 (T_a = 50°C FN12 Heat Sink									A
		11 (T_c = 25°C) 17 Ar.m.s.									



SCRs — MAXIMUM RATINGS — 10 Amp RMS

Item	Symbol	2SF 660	2SF 661	2SF 662	2SF 664	Unit
*Non Rep. P.R.V.	V_{Rsurge}	75	150	300	600	V
Rep. Pk-Fwd. Blocking Voltage	V_{FOM}	50	100	200	400	V
Repetitive P.R.V.	V_{RM}	50	100	200	400	V
Avg. Rectified Current	I_O	3.5 (Ta = 50°C FN11 H. Sink				A
		10 Ar.m.s.				

*GATE CIRCUIT OPEN.

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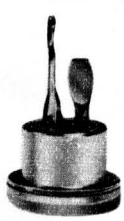
Interbase Voltage	V_{BB}	25	30	V
Peak Emitter Current	I_{EM}	1	1	A
Emitter Current	I_E	50	50	mA
Junction Temp.	T_J	+ 150	+ 150	°C
Storage Temp.	T_{stg}	− 40 ~ + 150	− 40 ~ + 150	°C

TRIACs — MAXIMUM RATINGS

ITEM	Symbol	AC06DR	AC10DR	UNIT
Peak Block Voltage	V_{BLM}	400	400	V
Conduction RMS Current	I_{RMS}	6	10	A
Surge Current	I_{surge}	50	70	A
Peak Gate Power	P_{GM}	5.0		W
Junct. Temp.	T_j	+100		°C



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RF PERFORMANCE OF ELECTROPLATED CONDUCTORS

The following article, a condensation of a paper by A. M. Fowler, M.I.R.E.E., originally published in the May, 1970, issue of the Proc. I.R.E.E. Aust., contains some interesting observations on the plating techniques currently employed in the electronics industry. Several of our cherished notions regarding the advantages to be gained by silver plating RF coils, for example, are shown to have no basis in fact.

Silver is frequently specified as an electroplated finish for conductors carrying RF currents for two reasons:

(i) Pure silver is usually thought to be the best conductor, having a relative conductivity of 105 per cent I.A.C.S. (The International Annealed Copper Standard. An annealed copper wire, density 8.89 g/cm^3, one metre long, weighing 1 gram and having a resistance of 0.15328 ohms, has a conductivity of 100 per cent I.A.C.S. at 20 deg. C.)

(ii) The tarnish film which forms on the surface of silver is often thought to have a low contact resistance.

The first statement is not strictly true in that samples of specially purified copper have recorded conductivity values up to 106.2 per cent. The second statement, likewise is incorrect. The silver deposit is readily attacked by sulphides in the atmosphere, resulting in a thirty or forty-fold increase in contact resistance and severe discolouration after only a few hours of exposure.

Unfortunately, it is almost impossible to produce an electroplated silver finish which has as high a conductivity as pure silver. At best the conductivity of the deposit will be about the same as pure copper and it is often much less. This effect is not confined to silver and the conductivity of most electroplated metals is less than that of the pure wrought metal.

Two of the most interesting points to come out of the investigation are:

(i) A thin plating of either very high conductivity or of very low conductivity over copper will have negligible effects on the overall RF resistance and

(ii) A plating having about half the conductivity of the copper base will cause the greatest increase in the overall resistance.

Further investigation has shown that the conductivity of much of the commercial silver plating is about half that of pure copper and is therefore unsuitable for use in radio frequency applications.

Commercial plating processes are mostly aimed at producing a fully bright deposit which will require no subsequent buffing. To this end most plating solutions contain proprietary brightening or grain-refining agents. These are either organic or metallic compounds which are absorbed by and/or co-deposited with the metal. The result is a very significant change in the physical properties of the electroplated finish and, in particular, a reduction in the electrical conductivity.

This decrease in conductivity is well documented in plating literature but does not appear to be well known among electronic engineers. This is surprising because of the number of papers published in recent years describing the increased losses caused by silver plating. In turn, the significance of the lower conductivity has been missed by the electroplaters. A typical comment from an electroplating text book states, "However, the higher electrical resistance is rarely of any significance in practice."

Skin effect, the crowding of the current in a conductor to the outer surface, makes the AC resistance of a conductor higher than its DC resistance. In a solid, homogenous conductor carrying AC, the current density decreases more or less exponentially from the surface. Skin depth, in turn, is defined for a plane solid as the depth at which the current density has fallen to 1/e, or about 37 per cent of the surface value.

In a conductor having a thin covering of another metal this exponential change no longer applies and there is a sharp step in the current density at the boundary of the two metals. At high frequencies the internal reactance and AC resistance are equal in a solid conductor but, because of the current redistribution, this is not always the case in the composite conductor.

Consider the case of a copper wire plated with a metal of lower conductivity. Typical curves are shown in Fig. 1. As might be expected, the resistance initially increases as the plating thickness increases, although slowly at

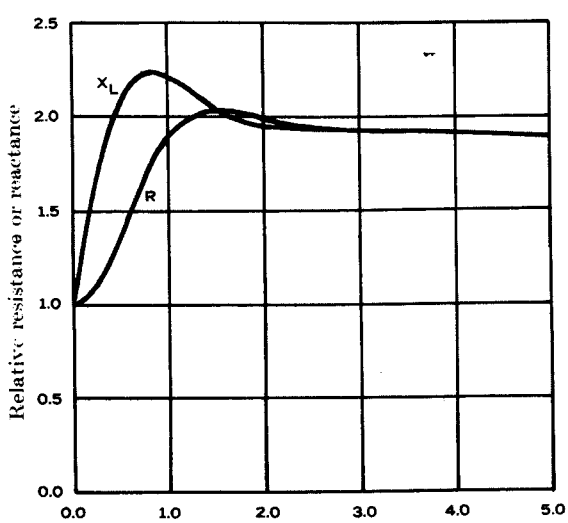


Figure 1 Thickness of plating (skin depths)

The AC resistance (R) and reactance (XL), at 10MHz, of a 0.25 inch dia. copper rod (conductivity 100% I.A.C.S.) plated with a metal of conductivity 25% I.A.C.S.

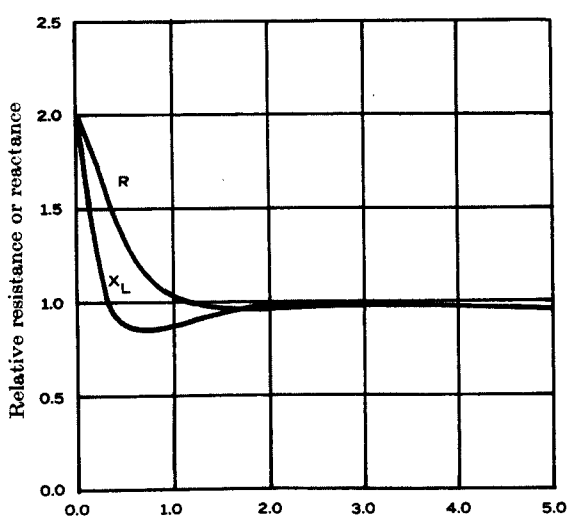


Figure 2 Thickness of plating (skin depths)

The AC resistance (R) and reactance (XL), at 10MHz, of a 0.25 inch dia. brass rod (conductivity 25% I.A.C.S.) plated with a metal of conductivity 100% I.A.C.S.

first. It then rises rapidly to a maximum value and then decreases as the diameter, and hence the cross-sectional area, is increased.

With a thick layer of plating the properties are similar to those of a solid conductor of the plating metal. The resistance of the composite conductor reaches a maximum when the plating thickness is approximately one and a half times the skin depth of the plated metal.

The reverse happens when the outer layer is a better conductor and the resistance drops to a minimum value when the plating layer is about one and a half times the skin depth as shown in Fig 2.

The shape of the curves is important. As stated earlier, the curve rises slowly at the start and, in fact, the lower the conductivity of the plating, the lower the initial slope of the curve. This means that, for a thin layer of plating, the lower the conductivity of the plating material the lower will be the resistance of the composite conductor.

This effect is shown in Fig. 3 and even more dramatically in Fig. 4 which is merely an enlarged section of Fig. 3.

Plating with a ferro-magnetic material such as nickel, which is often used as an underlay for chromium or silver, will cause very high losses. The skin depth decreases with an increase in both the conductivity and permeability of the plating material while the AC resistance decreases with conductivity but increases with permeability.

In a practical case, the tank coil of a 10 MHz high power transmitter was fabricated from a length of 3in dia. copper tube. This operated normally at 65 deg. C but when the coil was nickel plated the operating temperature rose to 350 deg. C.

The conductivity of the deposited metal is affected by:

(i) the composition of the plating bath;

(ii) the temperature of the bath;

(iii) the current density in the bath at the plated surface;

(iv) the surface preparation of the base metal and

(v) the thickness of the plated layer.

This variation in conductivity is not confined to the electro-deposits and is good reason why the grade of base metal should be carefully specified and checked. The conductivity of any metal is reduced by adding small quantities of other elements, either as alloys or as a mixture. As an example, the effect of the inclusion of other elements on the conductivity of copper is shown in Fig. 5.

Pure silver has a DC conductivity only 5 per cent higher than pure copper and at radio frequencies where the relative conductivity is proportional to the square root of the DC value, it is only about 2.5 per cent higher. This improvement is insignificant in terms of the "Q" factor. In view of this and the difficulty in producing high conductivity silver plating, why has silver plating been specified for electronic components for many years?

Most commercially available copper tube contains 0.015 per cent to 0.08

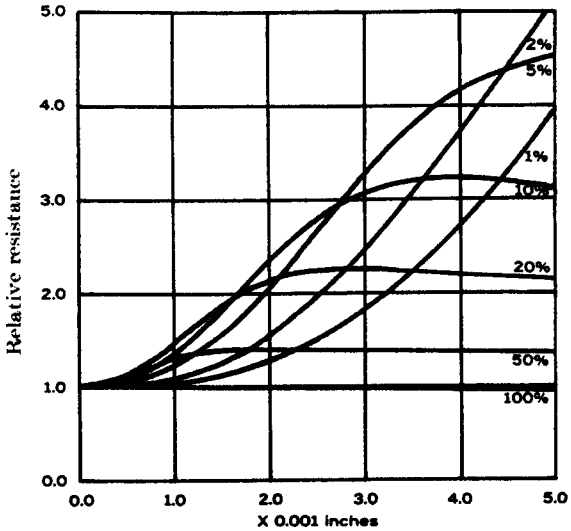


Figure 3 Plating thickness

The AC resistance, at 10MHz, of a 0.25 inch dia. copper rod (conductivity 100% I.A.C.S.) plated with metals of various conductivity. In each case the permeability of the plating metal is taken to be unity.

rhodium, neither of which is entirely satisfactory.

The problem basically is this: if silver plating is used, then apart from the problems of variable conductivity already discussed, a very thick layer of gold is required for corrosion resistance. Apart from the cost, the thick layer of gold cancels out any conductivity advantage which might have been gained from the silver layer.

With the currently used plating processes it should be possible to obtain better RF performance by plating a layer of high-conductivity copper instead of using silver at all. In fact, it can be shown that the most satisfactory low-loss finish can be produced by first plating with a high-conductivity copper and following this with a very thin layer of low-conductivity material, either metal or lacquer, to provide corrosion protection.

The diagram at right is an enlarged section of the diagram above and even more graphically illustrates the relatively slow resistance rise caused by very low conductivity plating metals.

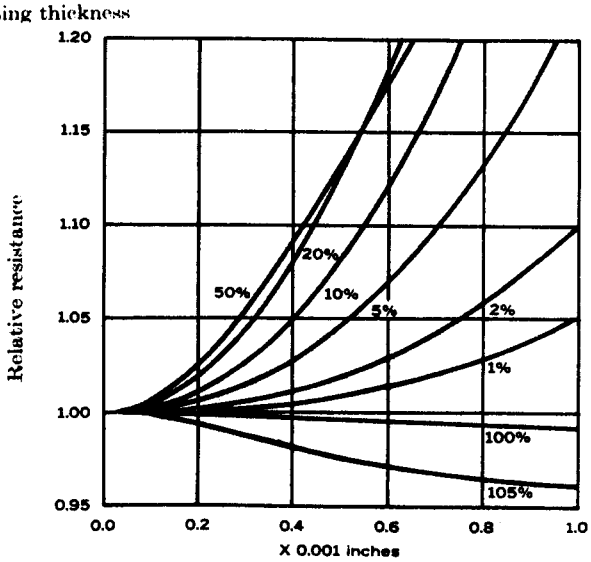


Figure 4 Plating thickness

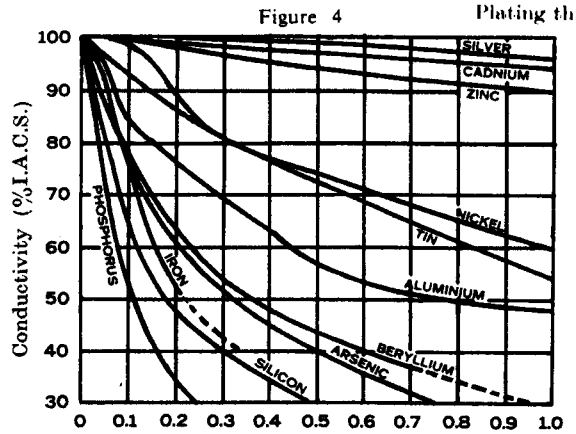


Figure 5 Percentage of added element

The effect of added trace elements on the conductivity of copper. It is quite normal for one or more of these "impurities" to be intentionally present in commercial grades of copper for a variety of reasons.

per cent phosphorous as a deoxidising agent so that its conductivity may range from 60 per cent to 90 per cent I.C.A.S. It was more than likely in the early days of radio, that silver plating would increase the "Q" of a coil because (a) the available copper tube had a higher impurity content and hence resistance, and (b) the silver plating process available at the time produced a very pure silver deposit of high conductivity.

This explains why silver plating occasionally reduced the losses in a coil wound from copper tubing and why the practice of silver plating electronic components has grown up over the years.

The position has changed in the intervening years, however, and present-day electrical grade copper has a conductivity of 101.6 per cent I.C.A.S., while the bright silver plates in common use have a much lower conductivity than pure silver.

Because the silver deposit is readily attacked by sulphides in the atmosphere, it is becoming increasingly common to specify a further protective layer, the commonest being gold or

A Balanced Input Microphone Preamplifier

Whenever low level signal lines are involved, as from microphones, extreme precautions are necessary to minimise hum and other spurious signal pickup. One of the most useful devices is the balanced line, and this article discusses the theory of its operation and describes a microphone preamplifier suitable for this type of input.

By George Hughes

An interesting application of a linear Integrated Differential Amplifier is in a unit that will substitute for the input transformer and, in a lot of cases, the first preamplifier in PA and recording equipment. It provides an input suitable for a balanced line, and either a preset or continuously variable method of gain adjustment.

To better understand the purpose and function of such a device, let us consider some of the difficulties associated with the transmission of audio signals over significant lengths of cable. Whenever we attempt to do this we encounter two basic problems: There will be loss of signal strength, probably frequency selective, due to the losses in the cable; and there will be a risk of unwanted signals being induced into the signal cable from any adjacent cables.

Losses in the cable can be due to any one of three basic characteristics — capacitance, resistance, and inductance — or combinations of them. Capacitance is probably the most frequent offender, resistance less frequently, and inductance rather rarely, though it cannot be ignored.

Cable capacitance, i.e., the capacitance between the two conductors in the cable, acts exactly as would a capacitor connected across the line at either end; it offers a lower shunt impedance to high frequency signals than to low frequency ones and, to a greater or lesser degree, attenuates the higher frequencies.

The extent to which this happens depends on a number of factors, including the rather obvious one involving the amount of capacitance in the cable. Even more important, however, is the impedance at which the line is working, that is, the terminating impedance at each end of the line. While we cannot spare the space to give a detail explanation here, the plain fact remains that, as the impedance is lowered, the losses due to capacitive shunting —or other shunt losses — decrease proportionally. If we make the impedance low enough, the losses can be reduced to a negligible amount.

But, as we might expect, there is a price to pay. While lowering the impedance reduces any shunt or parallel losses, it increases the series losses, the most significant one in most cases being the resistance of the conductors in the cable.

Losses due to resistance are not normally frequency selective and, therefore, are usually less objectionable than capacitive losses. In many cases they can be overcome by simply providing additional amplification at one or both ends of the line. However, there are limits to the extent to which this can be done.

Thus, it is necessary to settle for some kind of compromise when deciding on a suitable impedance for a particular line. Fortunately, in most cases, this is not particularly difficult, there being a fair "gap" between the critical values of each effect. A popular impedance is 500 or 600 ohms, as used in telephone type circuits, whether they be used for conventional telephone signals, or signals from other sources which have to be handled by the telephone networks.

Another value is 50 ohms, which is most useful where relatively short runs are involved and the problem of resistance is therefore unlikely to be serious. On the other hand, the lower impedance provides added protection against capacitive losses, as well as reducing the risk of unwanted coupling from adjacent cables.

At the other end of the scale, quite high impedances are sometimes used. Some microphones have an impedance as high as 50,000 ohms and require a similar impedance as the load presented by the amplifier. Use of such high values is normally confined to quite short lengths of cable, say a few feet, which is regarded as part of the microphone. In these circumstances capacitive loss can be held within acceptable tolerances. Should a much longer lead be required it is necessary to convert to a lower impedance, using a transformer, then reconvert to the higher impedance again at the amplifier end, using another transformer.

Another situation where high impedance lines are encountered is that involving crystal or ceramic microphones and pickups. These devices are, in effect, a very large capacitor. As a result, additional capacitance in the line does not cause a frequency selective loss. Rather it produces an overall loss which, within limits, can be compensated for by increased amplifier gain. In order to produce a suitable frequency response these devices require load impedances ranging from about 500K-ohms to 5Mohms.

Just as serious a problem as losses within the line is the risk of false signals being introduced into the line from adjacent lines. The most common example of this is the introduction of 50Hz hum from power mains into low level signal lines; a problem which most enthusiasts have encountered at some time. Similarly, where there are several signal lines in close proximity, as in switchboards, cable ducts, multipair cables, or even aerial lines, there is an ever-present risk of signals from one cable being induced into another.

There are a number of defences against this problem which may be used singly, or in such combinations as are necessary. Interaction between signal cables can be minimised by ensuring that all operate at about the same signal level. Fairly obviously, if any one cable carried signal at a significantly higher level than all the others, there would be a serious risk of unwanted coupling to the lines at the lower level, even though the line at the higher level would probably avoid any such problem. It is for this reason that P.M.G. engineers insist on quite stringent limits to the level which may be fed through their lines.

Operating the line at a suitable impedance can also be a help with this problem, particularly against hum pickup from power wiring. If the coupling is predominantly electrostatic the use of a low impedance system will help a great deal and is most valuable where it is impractical to shield the cables, by reason of space or cost limitations.

The use of shielded cable is probably the best known technique, such cable consisting of a single centre conductor

SPECIFICATIONS:

Frequency response (—3dB): 15Hz - 25KHz at maximum gain, increasing HF response at decrease of gain.
Hum and Noise: —56dB below 0dB reference, in shield box. (0db=0.775V RMS).
Input impedance: 100K unterminated.
Output impedance: Approx. 1K.
Supply voltage and current: 12V DC at 8mA.
Gain: 50dB max., 6dB min.
Balanced input with grounded reference. Unbalanced output with DC level. (see text).

insulated from a flexible braided outer shield. Together they form a pair, with the outer braid always connecting to the "earthy" side of the circuit. Such cable is quite effective in reducing electrostatic coupling from adjacent cables, power wiring, etc., and is all that is required in many cases. However, for a given physical size, such cable tends to have a higher capacitance between conductors, thus aggravating the problem of capacitive shunting and making it more necessary than ever to choose a suitable impedance for the system.

And even shielded cable is not good

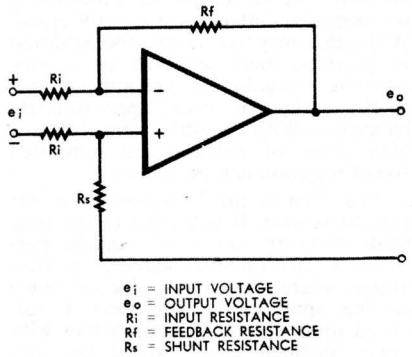


Figure 1. Conventional arrangement of feedback around a differential amplifier.

enough in some cases. Particularly where heavy magnetic fields are involved, the simple electrostatic shield may not be sufficient. In this case we can resort to a balanced line. The theory of a balanced line is not difficult to follow. Let us imagine a shielded cable with two internal conductors rather than one. The signal is now carried on these two conductors, with the shield being simply earthed and playing no part in the signal transfer.

At the amplifier, the two conductors are connected to opposite ends of a transformer winding. The winding is centre tapped, the centre tap connecting to the "earthy" side of the amplifier. The transformer secondary is connected to the input of the amplifier in the normal way, one side being "active," the other "earth."

As a result of this configuration, both signal conductors are deliberately exposed to the unwanted field. Because they are very close together they may be regarded, at the frequencies in-

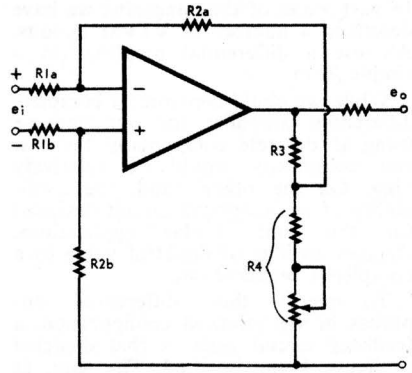


Figure 2. Additions to figure 1 to allow facility of variable gain with single control.

volved, as occupying the same position in space. Which means that the interfering field generates voltages of identical amplitude and polarity with respect to "earth," in each conductor. (The wanted signal voltages, on the other hand, have opposite polarities in the two conductors.) When we feed two voltages of the same amplitude and polarity into opposite ends of the transformer they cancel, and no unwanted signal appears in the transformer secondary.

Fairly obviously, the unwanted signal will only be completely cancelled if the opposite voltages are exactly equal. While this may not always be achieved in practice, there will still be a very effective reduction in unwanted signal if the system is even approximately balanced. With a little care quite a high order of balance and unwanted signal rejection can be achieved.

This then is the background to our present project. If you need to use long leads carrying low level signals, particularly microphone signals, in situations where there is a risk of intercepting spurious signals, then a balanced input system in conjunction with twin shielded cable would be well worth considering.

In our previous explanation we assumed the use of a transformer as the input device, and this is common practice. However, transformers of a quality good enough for this job are quite expensive. Not only do they need to handle the signal with negligible distortion, but being magnetic devices, frequently mounted in close proximity to power transformers, they need to be very carefully shielded against hum pick-up if they are not to become more of a liability than an asset. Complex design, high quality core materials, and such techniques as triple shielding with high quality magnetic materials are virtually essential, hence the high cost.

One way of overcoming this is to use a differential amplifier in place of the transformer. Using modern components it is possible to construct such a unit for considerably less cost than a high quality transformer, yet there should be no sacrifice in quality.

Briefly, a differential amplifier is one provided with two balanced input terminals. The circuit is commonly used to indicate a balance condition between two inputs. It is used extensively in industry as temperature controls, speed regulators, light level comparators and many other applications. In past issues of this magazine we have described a number of VTVM circuits. All use a differential amplifier in a simple form.

While we could construct a complete differential amplifier for our purpose using all descrete components, the cost and complexity would be relatively high. On the other hand, the availability of an integrated circuit designed for this and similar applications, changes an idea of doubtful value to a completely practical one.

To operate these differential amplifiers in the balanced configuration, a feedback circuit such as that depicted in figure 1 can be used. The gain, as calculated, is the ratio of the input and feedback resistors Ri and Rf respectively. Ri includes the generator and series resistor as a total in the calculation.

The actual input impedance of the circuit itself is the value of the series resistor Ri, when looking at the input terminals. If the generator impedance is a very small portion of Ri, it can be neglected in the gain calculations. Gain of the unit will reduce as the generator impedance increases, since the generator becomes a part of the feedback resistance as seen by the input terminal of the IC.

The differential amplifier ICs available at present all possess very high loop gain. As such, they require care in the design of the layout and the associated circuitry, if problems of instability are to be avoided. Some form of negative feedback is inevitably used, both to limit the gain and improve performance.

To fully understand the operation of the unit, the basic concept of the differential operational amplifier is shown in its simiplified form in figure 1. If an ideal amplifier is assumed, i.e. one with infinite input impedance and zero output impedance, it can be written;

$$e_o = -\frac{R_f}{R_i} \cdot e_i \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where eo and ei are the input and output voltages, respectively.

The ratio of input and output voltages is the gain (A) of the amplifier, or the ratio of input and feedback resistances. If the feedback and input resistances are equal, the gain of the amplifier is unity.

The all-important aspect of the balanced input configuration is its ability to reject in-phase and equal voltages present at each input at the same time. This rejection, now referred to as "common mode rejection," will be maximum when the input resistances Ri (a) and Ri (b) are exactly equal, and similarly when the feedback resistor Rf and shunt resistor Rs are exactly equal. For these reasons it is usual to specify Ri (a) and Ri (b) as a matched pair, and the two feedback resistors Rf and Rs as a matched pair.

The specifications shown are based on a 200 ohm source impedance, which is as popular an impedance as the 50 ohm one. An impedance range of this order will not cause more than 0.1 per cent gain error.

A variation in gain can, in theory, be made by using a ganged potentiometer similar to that used in stereo applications in place of either Ri (a) and (b), or Rf and Rs. Unfortunately, the commercial quality ganged potentiometer does not possess sufficient freedom from tracking errors between elements, and cannot be used without upsetting the common mode rejection of the whole amplifier.

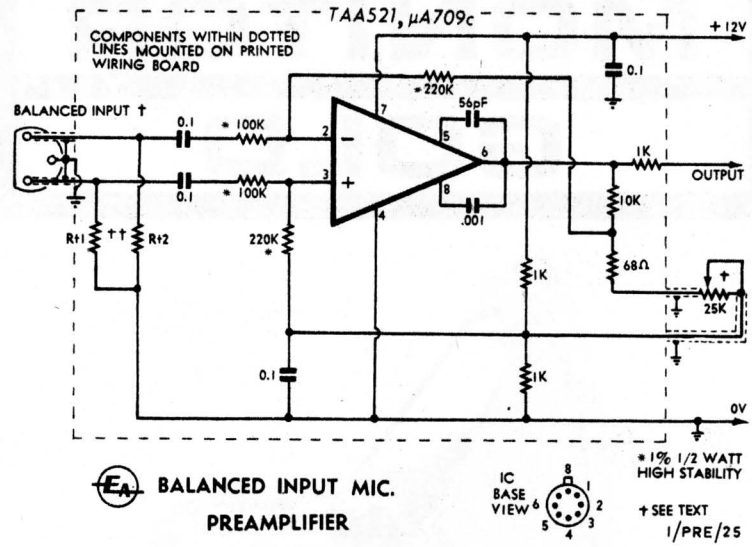
With a typical microphone sensitivity of -60dBM (equivalent to approx. 0.33mV RMS), it can be seen that even a very small hum voltage can cause a lot of trouble if not properly balanced out. The common mode rejection figure under such tight conditions, therefore, has to be of a high order.

In any feedback amplifier, a voltage derived from the output is superimposed upon the amplifier input in such a way as to oppose the applied signal. Negative feedback is introduced by superimposing on the amplifier input a fraction of the output voltage, so that the actual input voltage consists of the difference of the signal voltage and the feedback voltage.

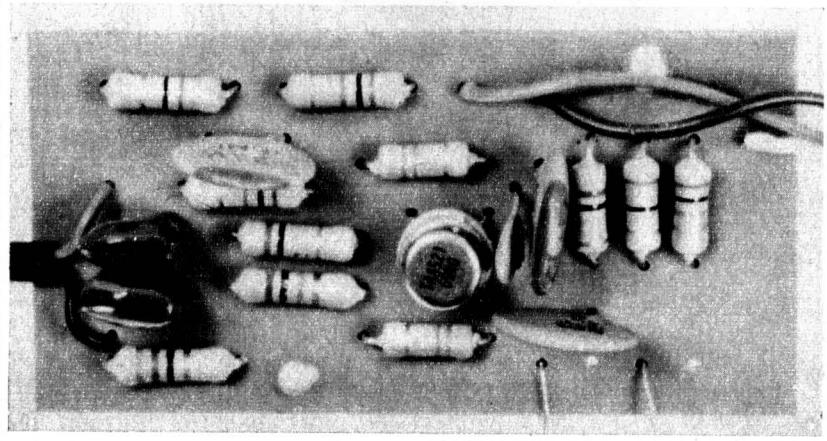
To equal the output voltage, this input voltage must be amplified by the gain (A) of the amplifier. By definition, the voltage gain of an amplifier is the ratio of the input and output voltages, and is a characteristic of the amplifier itself, irrespective of any external feedback circuits that may be applied.

If negative feedback is applied to an amplifier, the actual gain of the amplifier can be controlled by the external feedback circuit.

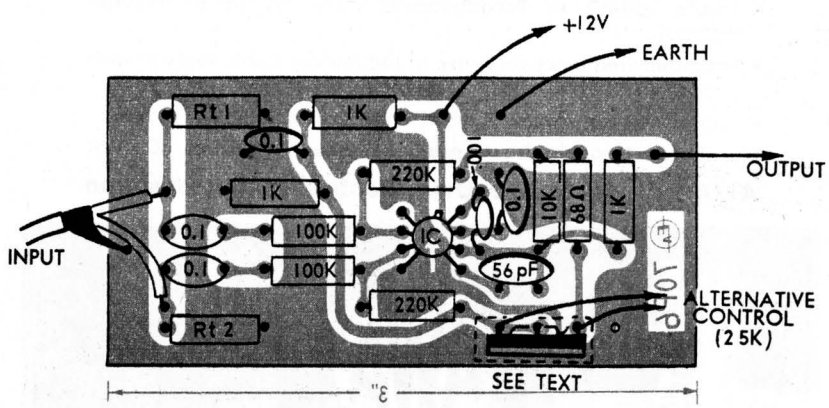
The gain of the differential amplifier is controlled by applying feedback in the same way as in a conventional voltage feedback amplifier. In the differential amplifier, there are two inputs available, a non-inverting input, and an



This is the schematic of the complete Balanced Microphone Preamplifier using the TAA521 or uA709C integrated circuit. External 12 volt sources are discussed in the text for operating single or multiple units.



Top view of the circuit board showing all components. Normally a shielded pair or two short wires are connected to a variable gain control, but the circuit board will accept a preset potentiometer.



X-ray view of circuit board showing the component positions as viewed from the component side. The position of the preset gain control is shown, but holes are provided for a variable control.

inverting input. These are so named to indicate their phase relationships with the output. The inverting input signifies that the output is 180 degrees out of phase with the input; and the non-inverting input has zero phase shift. The amplifier gain is identical from each of these inputs.

When feedback is applied to the inverting input, we have negative feedback. When feedback is applied to the non-inverting input, we have positive feedback.

In the balanced, or differential amplifier, the feedback is applied between the output and the inverting input, and is shown in its basic form in figure 1. The refinements of variable gain will be covered as we proceed. In figure 1 the output, as fed back via the resistor Rf, is reduced in amplitude by the ratio of Rf:Ri at the input. Similarly, the signal ei flowing through the series resistor Ri will be reduced in amplitude by the ratio of Ri:Rf at the input terminal of the amplifer. When these two voltages meet at the input terminal, they will subtract because of their phase difference of 180 degrees.

The remaining voltage will be amplified, a replica of which will appear at the output equal to A times this voltage at the input terminal.

The non-inverting input will also be reduced to the same amount as the inverting input, but by a different mechanism.

The input circuit of a differential amplifier consists of a pair of identical transistors connected in the "long tailed pair" configuration. This type of circuit shares a common emitter impedance of some form such as a resistor or the collector circuit of a third transistor so connected to act as a constant current source.

If current is lost in one transistor, it will be gained by the other to maintain a constant current through the common emitter impedance. Now, if the two transistors are identical, their current gains will be equal, and hence will experience the same ratio of current loss and gain at their respective emitters. By Ohm's law, this loss and gain in base current will also give an identical ratio of loss and gain of voltage through the input voltage dividers, and so each input will experience the same control of feedback, one directly and the other indirectly.

Variable gain control is applied to the amplifier by an arrangement as shown in figure 2. Instead of directly connecting the feedback resistor to the output, it is connected to a voltage divider between the output and ground. As the feedback point is taken closer to ground, the feedback is reduced with a proportional rise in gain. If the feedback resistor (R2a in figure 2) is taken directly to ground (R4 zero), we will have the maximum possible gain of the amplifer, or open loop gain. If R4 is infinite, the gain will be dictated by the ratio of R2a:R1a, assuming that the value of R3 is much smaller than R2a.

In this extreme case, the gain could be varied from less than unity up to the open loop gain of the amplifier itself (typically 45,000 or 90dB) without upsetting the common mode performance to any noticeable degree. Thus, the ratio of R2 to R1 can be adjusted to optimise common mode rejection

and then left without further adjustment. For this optimum adjustment;

$$\frac{R_2}{R_1} = \frac{R_{2a}}{R_{1a}} = \frac{R_{2b}}{R_{1b}} \quad \ldots\ldots\ldots\ldots (2)$$

For the best performance, the four resistors R1a, R1b, R2a and R2b should all be high stability types, with a 1 per cent tolerance. Alternatively, R1a and R1b; R2a and R2b should be matched within 1 per cent with an accurate resistance bridge.

By controlling the gain this way, an expensive and very closely matched ganged potentiometer can be avoided.

If high stability close tolerance resistors are not available, a close match within 1 per cent must be made of R1a and R1b, as well as R2a and R2b. Resistor tolerances can be allowed up to 20 per cent if desired, but the likelihood of finding two pairs of identical resistors will be remote unless there is a hundred or so of each value available.

The overall gain of the circuit using a single potentiometer for the control of gain becomes:

$$A = \frac{R_2}{R_1}\left(1 + \frac{R_3}{R_4}\right) \quad \ldots\ldots\ldots\ldots (3)$$

where A is the voltage gain, and all R values are as in figure 2.

Applying these formulas to the amplifier and subsitituting a single control for a portion of R4, the values indicated in the full circuit will allow a gain control range of 6dB to about 50dB (or voltage gain from 2 times to 316 times). This range of control will be more than adequate for the greater majority of applications.

The minimum gain of 6dB (2 times) is set entirely by the 68 ohm resistor connected in series with the potentiometer, which is a portion of R4. For this 68 ohm resistor to be in circuit at minimum gain setting, the potentiometer's zero shaft position would have to coincide with zero resistance, as any remaining resistance in the potentiometer will be a bigger portion of R4 than that provided by the 68 ohm resistor, with a higher than minimum gain of 6dB as intended. If this 6dB minimum gain is essential, it is wise to check the absolute zero of the potentiometer if this requirement is to be satisfied.

From the point of view of wear, the professional carbon track potentiometer is best, but a standard or preset type will be quite satisfactory if the control is not to be adjusted on a regular basis.

If the main amplifier is already provided with a gain control, a preset potentiometer will be adequate. The circuit board is provided with the necessary holes to allow a preset potentiometer to be installed.

A further requirement is frequency compensation. This compensation is required to minimise an inherent limitation of bandwidth and associated phase shifts within the device. These phase shifts can introduce instability as bandwidth and gain are increased. Compensation is provided by two capacitors, one each connected between the output and one of two compensation terminals designated "input frequency compensation" and "output frequency compensation" respectviely.

If the IC is operated at a fixed gain, a maximum bandwidth could be extracted by choice of a series resistor/capacitor combination that would present the correction necessary to achieve this without fear of instability. However, our amplifier operates as a variable gain device, and such compensation would result in a conditional stability; stable in certain gain positions, and unstable in others. The capacitors indicated in the main circuit schematic have been chosen to allow 50dB of voltage gain with a minimum bandwidth of 25KHz.

The low frequency 3dB point is 15Hz. This figure is determined by the value of the input coupling capacitor. With an impedance of 100K at each input, a 0.1uF capacitor will give this result. It may seem that there is little point in making the low frequency response extend to this frequency, but it will ensure that the full useful range of the microphone will not be limited in any way.

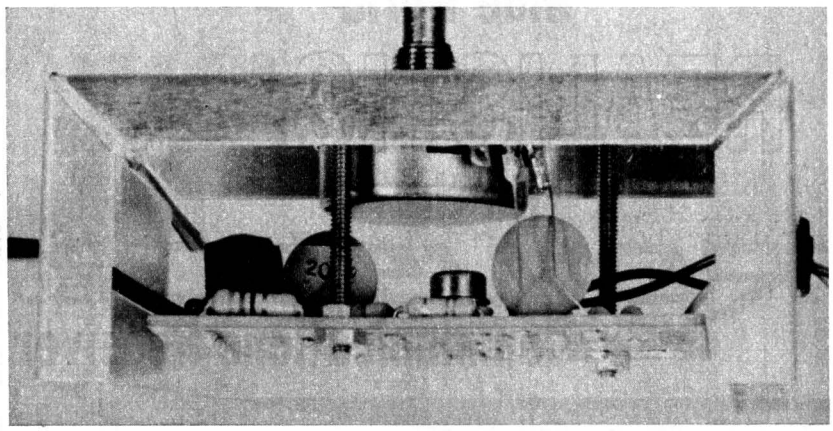
The terminating resistors Rtl and Rt2 connected in series form the load and termination for the microphone line. They also provide a mid balance point which is connected to ground, and obviates a "floating" microphone line. A symmetrical supply line is eliminated by placing two resistors of equal value in a series fashion between the positive supply and ground. The junction between these two resistors forms a common return for a part of the circuit. Adequate bypassing to AC is provided by two ceramic disc capacitors at the supply input and the resistor junctions.

This method of decoupling is essential with integrated circuits, as it must be remembered that there is an exceptionally high gain, particularly in the open loop condition, all within the space of half an inch. Layout is also a very important consideration, as discrete components themselves are potential stray coupling devices. It is a good plan, when constructing the unit, to adhere rigidly to the layout as shown, otherwise oscillations and other undesirable troubles could occur.

Output protection is provided by a series resistor of 1K connected to the output terminal of the IC. This will limit the current to 6mA if a very low impedance load is encountered outside the board. The maximum output current for the two types of IC nominated is 50mA, and values in excess of this for a brief period will destroy the output amplifier in the IC. Such a condition could be caused by a direct short circuit or low impedance load connected via a capacitor.

Because of this series limiting resistor, any external loading on the output lead will give a lower voltage output than the open circuit condition. For a given load, simple voltage divider calculations will determine the voltage change that can be expected at the output.

Input protection is provided by the microphone terminating resistors Rt1



A side view of the preamplifier with its cover removed. The variable gain control is above the circuit board, but it could be mounted in a remote position if desired, connected by a length of suitable cable.

PARTS LIST

1 uA709C or TAA521 integrated circuit.
1 Printed board (ref. 70/p6).
1 BZY88-C12 zener diode (see text).
1 Shield box.
RESISTORS: (¼ watt 5 p.c. unless stated).
2 220K 1 p.c. high stability.
2 100K 1 p.c. high stability.
1 10K.
3 1K.
1 68 ohm.
1 25K potentiometer, Plessey type E or similar, or preset type. Logarithmic law.
2 Terminating resistors to suit microphone (see text).
1 47 ohm decoupling resistor (see text).
1 Zener diode series dropping resistor (see text).

CAPACITORS:
2 0.1uF 25V ceramic disc.
2 0.1uF miniature polyester.
1 56pF NPO ceramic disc.
1 0.001uF ceramic disc.
1 Output coupling capacitor (see text and table).
1 500uF 15V electrolytic (see text).

SUNDRIES:
1 Balanced line input connector (Cannon XL or similar).
Shielded pair cable with outer sheath.
Control knob.
Mounting pad for TO-99 package.
2 Small rubber grommets.

and Rt2. The lower the value of these resistors, the greater the protection there is to the amplifier input circuit. It is recommended that a totally shielded input connector be used to couple the microphone cable to the amplifier, preferably one of the types that disconnects the grounding pin (or shell) last of all. Such a unit is available in the Cannon XL series, and no doubt there are others available that will perform the same function. If the three pin type similar to that in the photographs is used, the cable itself should be connected as shown with the screen grounded at the amplifier. The shell of the connector should be grounded to the chassis of the main amplifier or to some convenient ground point.

Irreparable damage can be sustained at the base-emitter junctions of the input transistors within the IC if the correct type of connector is not used. High electrostatic charges can be built up on the cable and, at the moment of connection, these charges can be released into the junctions if they are not grounded before the two inner leads make connection.

Connecting the unit to an existing amplifier is a simple matter. Two points are worth mentioning, one being to check if a coupling capacitor is required between the two, and the other point is the provision of the positive 12 volt supply. The coupling capacitor, if an electrolytic, should have the positive terminal connected to the most positive side of the circuit. The size of capacitor will determine the lower 3dB point, and is dictated by the impedances around the circuit.

If the external circuit impedance is lower than the output impedance of the unit, the capacitor size will be determined by the unit's impedance of 1K. If higher, the capacitor will be determined by the external circuit. For 1K or less, the capacitor whose reactance at 15Hz is 1K, has a capacitance value of 12.6uF (nearest preferred value). Output capacitance values can be calculated from the formula for capacitive reactance, or a suitable size chosen from the table. The capacitor whose value corresponds to the next lowest impedance should be chosen.

OUTPUT CAPACITOR VALUES:
(Where 15Hz equals 3dB)

Impedance	Capacitor
5K	2.2uF
10K	1.0uF
20K	0.56uF
50K	0.22uF
100K	0.1uF
500K	0.22uF
1M	0.01uF

The current drawn by the unit is of the order of 7-8mA, and if a 12-volt source is readily available, it should be decoupled with a series 47-ohm resistor and 500uF 15-volt capacitor to effectively remove any trace of ripple from the power supply. For higher voltage supplies, a series resistor and zener diode arrangement can be made using a zener diode such as a BZY88-C12 or similar, allowing a total drain of 20mA, 8mA for the unit and 12mA for the diode. The resistor value and dissipation can be calculated from Ohm's law. Additional units can be fed from the same diode stabiliser.

provided sufficient current can be fed through the resistor to supply the total number of units, plus the 12mA required for the diode.

Interaction between units will be minimised if each one is fed from a separate decoupler, as a zener diode possess a certain dynamic resistance which can only be lowered by suitable bypassing or decoupling methods.

Mounting the board and potentiometer in a small metal box similar to that shown in the photograph can be readily achieved with suitable bolts and spacers. This can be varied to suit individual concepts and space limitations. If desired, the potentiometer can be mounted in a remote position, provided the connecting cable is screened to and from the circuit board.

To assist in assembly, a printed board layout and matching component overlay is shown.

The integrated circuit is available in two types of package. The TAA521 has a TO-99 envelope, whereas the uA709C is available in two forms. The first is the TO-99 (same as the TAA521), and the second is a new abbreviated version of a dual in-line 14 pin by Fairchild. Two pairs of pins have been removed from one end and one pair from the other, resulting in a dual in-line 8 pin unit. The connections remain the same as the TO-99 package, and the board has been designed to accept this package.

The arrow on the foil side of the board indicates the direction of insertion for both types of package. In the TO-99, the lug on the case is directly beside pin 8, reading from the pin side. In the dual in-line, the arrow marks pin 8 to the left, when viewed from the pin side. If the IC is inserted with this in mind, no mistakes will be made when mounting the package.

The TO-99 package should be mounted centrally between the two rows of holes placed for the dual in-line unit, taking care not to bend the leads closer than 1.5 mm from the seal. Some suppliers have a small mounting pad available which allows freedom of bending the leads without fear of fracturing the seal. It also gives a "professional touch" to the appearance.

Leads to all other components should be kept as short as possible. When soldering, care should be exercised not to overheat the foil and the high stability resistors. The use of a thermal shunt made from a crocodile clip with two pieces of copper soldered between the jaws is recommended. Use a soldering iron with a clean, dross-free tip, properly shaped so that the solder flows quite readily. Only sufficient heat should be used to adequately flow solder into the joints to make reliable connections. It is better to apply heat for a slightly longer period, than to find that reheating of the joint is necessary to effect a reliable joint.

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TWO SOLID-STATE RF PREAMPLIFIERS

An RF amplifier for short-wave receivers, with a wide frequency range, has always been a stage in which the design presents more than its share of problems. This was the case with valves and is now somewhat more so with solid-state devices. Here, we present some ideas as to how this problem may be approached with a satisfactory degree of success.

By Ian Pogson

Somewhat over a year ago, in May, 1969, to be exact, we described a solid-state RF preamplifier for short-wave receivers. This design used a single low cost FET as the active element, together with four switched ranges to cover from 1.5 to 30MHz. Apart from the interest centred on the FET, the coils were all wound on ferrite toroids. These toroids allowed a high-Q coil, with all its advantages, together with a minimum space requirement and ease of construction.

This design proved to be quite successful and, with some modifications, was adapted for use in the recently described 240 Communications Receiver. The modifications apply to a change in the coil winding details to give broadcast band coverage and a different set of ranges, as well as the application of AGC to this stage of the complete receiver.

An important point which emerged, when this RF Amplifier was integrated into the 240 Communications Receiver, was the very good signal-to-noise ratio which was achieved. This has turned out to be so good that one gets the impression that the receiver is "dead" until a signal is tuned in. On the other hand, cross-modulation was evident, needing to be combated, with reasonable success, by introducing some aerial attenuation.

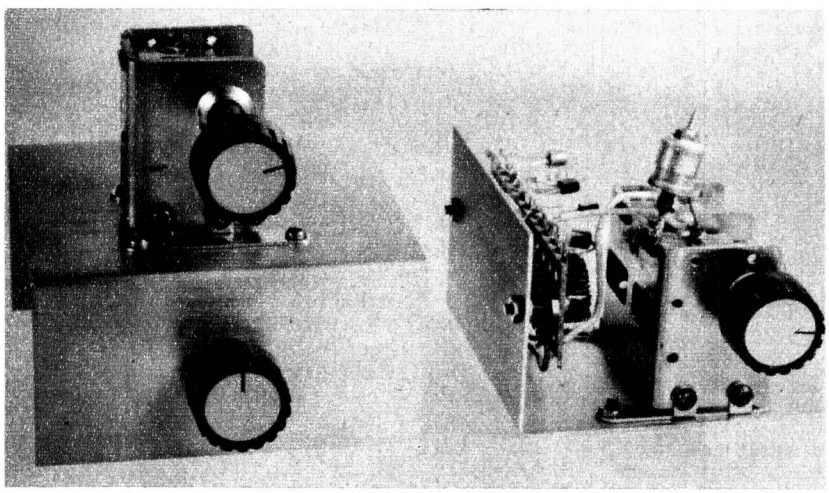
In valve amplifiers, the "cascode" has a reputation for low noise, with good cross modulation and AGC characteristics. The cascode configuration has recently been introduced into the field of solid-state devices and we therefore decided to make up an amplifier along these lines.

First of all, we decided to stay with the original idea of using junction FETs, but a change to a high frequency type was considered to be a forward step. The 2N5459 was therefore replaced with a 2N5485.

If we are to use a cascode circuit, shall it be series or parallel fed? This one was fairly easily solved. Since this type of FET should preferably be fed from a source of about 12 volts and since the supply voltage was to be 12 volts, each FET would only have a supply of half this value if we used series feed. By parallel feeding, each FET would have the full available supply voltage; and so it was.

What prompted us to look deeper into the RF amplifier problem, is the need for the best possible design, within reasonable limits, for a solid-state version of the Deltahet receiver, on which we are working when time permits. The main circuit diagram shows the details of development thus far. It could serve as the basis for an RF preamplifier to put in front of an existing receiver or as the basis for the first stage in a new receiver.

If your receiver is reasonably modern and has an RF stage, more than likely it will be adequately designed for good sensitivity and signal-to-noise ratio, as well as such other considerations as image rejection. Such being the case, you are unlikely to be interested in an outboard RF preamplifier. On the other hand, if your receiver is an old one, with an old type valve in the RF stage, or if it does not have an RF stage at all, you may be interested in the designs which we are about to present.



These pictures show the two versions, both electrically and physically, of the RF amplifiers. The physical forms are suggestions only and the final arrangement is left to the builder. Due precautions must, of course, be taken with layout so that no instability troubles will be encountered.

We have already mentioned having settled for an amplifier using the "cascode" configuration. Let us take a look at the main circuit diagram, ignoring for the time being the coils and tuning systems generally. The cascode actually consists of two distinctly defined stages. The first is a straightforward grounded source (cathode or emitter) with signal input to the gate (grid or base) and with the output from the drain (plate or collector). This is followed by a grounded gate (grid or base) amplifier, with input to the source (cathode or emitter) and output from the drain (plate or collector).

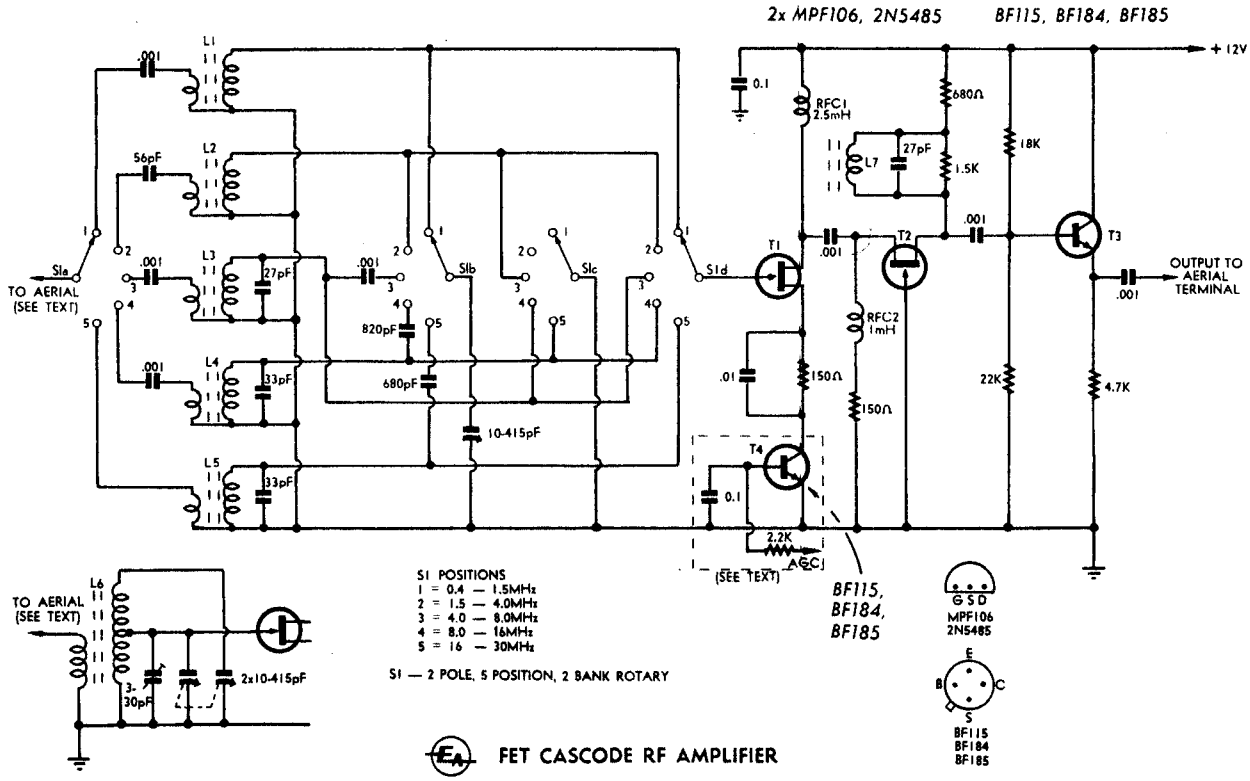
Looking at each part separately, a grounded source stage normally has a high input impedance and a high output impedance. A grounded gate stage normally has a very low input impedance and a high output impedance. As can be seen from the combined circuit of these two parts, the output of the first section is looking into or shunted by the input of the second section. This means that the output of the first stage is severely loaded and the amplification of this section is greatly curtailed. However, the second section is able to provide its full amplification and most of the amplification from the system comes from this latter section.

Note that the overall cascode circuit has a high input and high output impedance, free from the embarrassments which a low impedance circuit can sometimes cause.

The first section of the cascode uses a type 2N5485 FET, with the tuned circuits looking into its gate. A bias resistor of 150 ohms, shunted by a .01uF capacitor, is in the source return path. These two items are normally grounded, although they are shown in series with a bipolar transistor. More will be said about this transistor later on. The value of 150 ohms for the bias resistor is a design centre value for this type of FET and normally should be adhered to. The drain load is a 2.5mH RF choke.

The second part is fed from the source of the preceding stage, via a .001uF blocking capacitor. The gate is grounded directly. In the source circuit, is another 150 ohm bias resistor. So that the input impedance of this stage will not be any lower than necessary, a 1mH RF choke is connected in series with the 150 ohm resistor. The drain load for the second part is complex, in that there is a resistive load of 680 ohms, in series with a parallel tuned circuit. The latter circuit is resonant a little lower than the upper tunable frequency of the system, which is 30MHz. The idea of this arrangement is to try to keep the gain of the system reasonably constant over the whole tunable range.

The parallel resonant circuit in the source load of the second stage is



The main circuit diagram shows the version where a set of coils is switched in the conventional way. At bottom left, is shown the alternative tuning arrangement. The transistor in the drain of the first stage is included as a suggestion for a means of automatic gain control of the amplifier. This may be omitted, the 150 ohm resister and bypass running straight to earth.

heavily damped to smooth out the gain near the high frequency end, between about 25 and 30MHz. The two RF chokes involved between the two parts were chosen to have different values as a precaution against possible spurious oscillation.

As the output impedance of the cascode amplifier is relatively high and we want to feed it into a low impedance circuit, such as the aerial terminal of a receiver to retain the gain achieved, we have used an emitter follower stage to effect the impedance transformation.

Having discussed the amplifier section of the circuit, let us now turn to the tuned circuits. In line with our previous efforts, we are again using coils wound on Ducon ferrite toroids. These give coils which are reasonably easy to wind, are compact and have a high Q, making them ideal for our purpose.

From the aerial, the signal is directed to the appropriate coil primary, via a rotary switch. It will be noted that in most cases there is a series capacitor in this circuit. These have been introduced in an effort to further even out the overall amplification of the system. These values could be subject to some experiment, if the reader so desires.

To restrict the frequency coverage of each coil, using a 415pF tuning capacitor, a fixed capacitor is connected between the tuning capacitor and each coil, where this is necessary, with individual values selected to suit the required range. These capacitors are interposed between the coil and its switch contact.

The signal level across the variable capacitor is limited to the ratio of the variable and fixed capacitor, and is less than the full value as measured across the coil. It is therefore necessary to take the signal from across the coil. This involves using a third switch section on the range selector switch, the rotor feeding directly to the gate of the FET.

To restrict further the frequency coverage of each band, this time at the high frequency end, where necessary, a fixed capacitor is connected across hte coil.

External fields around the toroidal coils are very small and coils of various ranges may usually be located close together without serious problems with "suckout." Nevertheless, we did detect some evidence of the effect and as we had a spare section on the range selector switch, we used it to short out certain coils.

So much for the basic design of the system. When this unit was being discussed earlier on, the Editor suggested that it might be a good idea to present an alternative and much simpler tuning system, still feeding into the same amplifier. The tuning system referred to is one which has been around for a long time. It is the multiple tuning circuit which, among other places, was used in an RF amplifier which was described in the magazine in August, 1962.

The circuit of this tuning system is shown as an alternative tuning system, along with the main circuit diagram. Instead of the five separate coils, with their capacitors and switching system, there is only one coil, with a two gang variable capacitor, instead of the single gang used above. It will be noted that there is a tap on the secondary of the coil, with a single winding for the primary.

With this arrangement, we can cover

COIL WINDING DETAILS

L1 Sec. 100 turns 25 B & S En. to occupy 100 per cent of former. Prim. 3 turns interwound at earthy end of sec.

L2 Sec. 50 turns 23 B & S En. to occupy 100 per cent of former. Prim. 7 turns interwound at earthy end of sec.

L3 Sec. 18 turns 23 B & S En. to occupy 50 per cent of former. Prim. 3 turns interwound at earthy end of sec.

L4 Sec. 8 turns 18 B & S En. to occupy 50 per cent of former. Prim. 2 turns 23 B & S En. interwound at earthy end of sec.

L5 Sec. 4 turns 18 B & S En. to occupy 33 per cent of former. Prim. 1 turn 23 B & S En. interwound at earthy end of sec.

L6 Sec. 27 turns, tapped at 8 turn, 21 B & S En. to occupy 75 per cent of former. Prim. 2 turns interwound at earthy end of sec.

L1 to L6 all wound on Ducon type F4040/2 ferrite toroid formers, of Q2 material.

L7 12 turns 23 B & S En. straight on thread of 7.6mm x ¼in long iron dust slug. Neosid grade 900 or similar. Exact diameter not important.

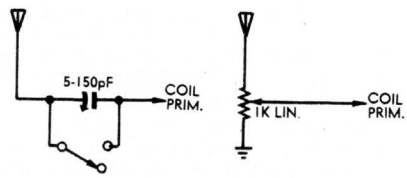
from 2MHz to over 30MHz in one sweep of the dial. This may seem incredible and even impossible at first sight. However, at the risk of a little over simplification, this is how it works.

Consider the full winding first, with one section of the gang across it. This is a simple parallel tuned circuit and could reasonably be expected to cover from some low frequency, say about 2.5MHz, to about 10MHz. In addition to this function, however, the other section of the gang is connected across the tapped section of the coil. This has much less overall effect than the first section, but might augment the former to make the overall tuning range from say 2MHz to 10MHz.

Now consider the small tapped part of the coil, with one section of the tuning capacitor across it. On its own, it is reasonable to assume that this circuit will resonate over some higher frequency range than that of the full coil and tuning capacitor.

In fact, that part of the coil winding above the tap is somewhat larger than that part below the tap and, at high frequencies, this larger part of the coil "looks like" an RF choke. This RF choke effect virtually isolates the lower resonant circuit from the rest of the circuit over the higher frequency range. By correct selection of the tapping point on the coil we can make this circuit tune from say 10MHz to above 30MHz.

This is just what happens and we have a second tuning range from 10MHz to well above 30MHz. To limit the upper frequency of this range, we have added a variable trimmer across this section of the gang, so we can adjust it to cover from 10MHz to 30MHz for our purpose.



These aerial attenuators are suggested methods for limiting signal input. Either one can be used, depending on which seems best to meet the particular situation.

The two ranges just cited, 2MHz to 10MHz and 10MHz to 30MHz, are, in fact, the ranges of our tuning system and we have plotted these on a graph, which is reproduced in these pages. From this can be clearly seen the two frequencies for any particular position on the tuning calibration.

As mentioned during our discussion of the switched coil system, there is always the problem of keeping the gain reasonably constant from the lowest to the highest tuned frequency. In the normal course of events, the gain falls off seriously at the high frequencies, where it is most needed and the gain is highest at the low frequencies, where it is least needed! (Murphy's Law perhaps.) In the multiple tuning circuit, it will be noted that the gate of the amplifier is fed from the tap on the coil. This gives the full voltage to the amplifier from the high tuning range but taps down

for the low tuning range, just what we need. It helps to level out the gain in quite a neat fashion.

From the discussion of the multiple tuning circuit, it would seem reasonable to ask, why go to all the bother with the other system using switched coils? This is a fair question. In fact, there are some "catches" to the multiple tuning system. It will be up to the reader to sort out the pros and cons.

Although we only have one coil and need no switch, a two-gang tuning capacitor is required. This is probably a minor point. Also, with this system, it is not easy to get coverage right down to the broadcast band while going up to 30MHz. A no less important point is the fact that this system tunes to two frequencies at once. In some circumstances, this could mean that a wanted signal could be interfered with by an unwanted signal coming through on the second tuned frequency.

Under most conditions of use, this RF amplifier and tuner would be used with a receiver which would be tuned to the wanted frequency and would be able to discriminate well enough against the unwanted signal. However, if we went to the trouble to make the system cover the broadcast band as well, it is almost certain that problems would be encountered with strong local broadcast stations breaking through where they were least wanted. But, to sum up, this system is well worth a trial.

Earlier in this article, we mentioned the application of AGC to the RF amplifier. Normally, when this unit is used outboard, AGC would not be applied. Later, we will deal with some means of manually controlling this stage. In the main circuit, we show a bipolar transistor in series with the bias resistor of the first stage. This transistor can be part of an elaborate and very effective AGC system of a complete receiver.

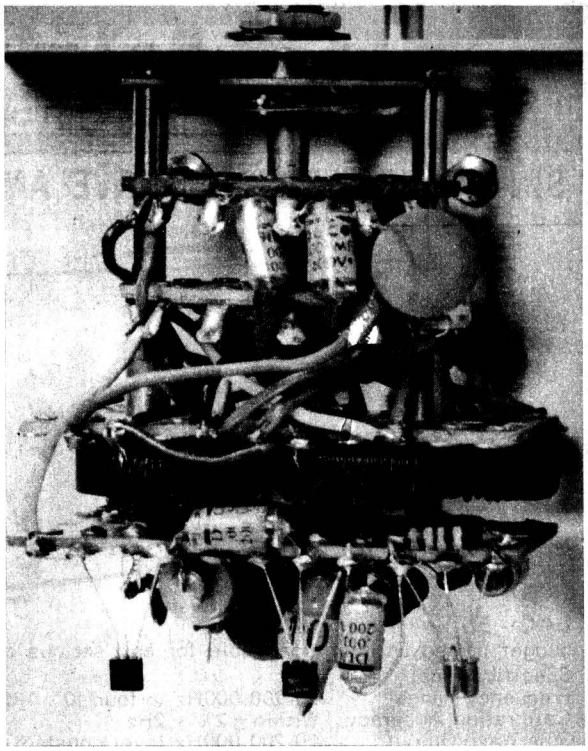
Under full gain conditions, the bipolar transistor needs to be so biased by the AGC system as to be "bottomed" or fully conducting. This means that the effective ohmic resistance between collector and emitter will be very low indeed. This resistance is effectively in series with the amplifier source circuit, and, being very small, will have negligible effect on the amplifier.

When the AGC becomes operative, the forward bias to the bipolar transistor must be reduced progressively. This effectively causes an increase in the collector-emitter resistance of the transistor and this in turn is introduced into the source circuit of the amplifier. This resistance is not bypassed to RF and so has a degenerative effect on the signal into the amplifier. This effect increases or decreases according to the strength of the received signal. With this system of AGC, it is possible to get a very high degree of control and it is one of the better systems in use today.

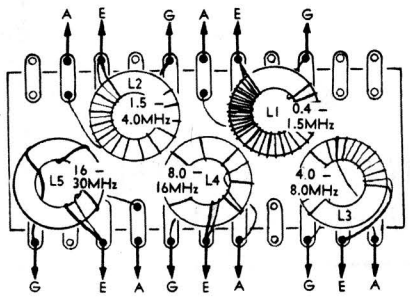
An alternative AGC system which may be applied to this type of amplifier has already been shown in the 240 Communications Receiver, recently described. The system consists of applying an increasing negative control voltage with increasing signal strength, to the gate of the first part of the RF amplifier. To do this, a "gate leak" must be introduced into the gate circuit, with a DC blocking capacitor. The AGC voltage is fed into the lower end of the "gate leak" resistor. Instead of the shunt feed system just described, the AGC voltage could be series fed via the tuning coils.

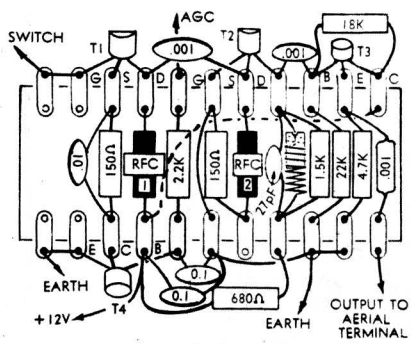
For those not requiring an AGC facility, an effective manual control may be fitted by introducing a variable resistor in the form of a potentiometer, in series with the 150 ohm bias resistor, in the position shown for the bipolar AGC transistor. The maximum value of the potentiometer may be between about 10K ohms and 50K ohms.

At right is the underneath view showing the overall assembly for the coil-switched version. Wiring and assembly details are given in the text.



Below is the suggested wiring diagram for the board containing the five toroidal coils.





This wiring diagram gives details of the component board for use with the switched coil version. The two above boards should be orientated carefully to make for short wiring leads.

Another problem relating to RF amplifiers and which was mentioned earlier, is that of cross modulation and other related problems. An effective method of dealing with this nuisance is to insert some form of attenuator in the aerial circuit. Two simple methods of doing this are shown in an accompanying diagram. One is simply a 1K potentiometer across the aerial input, with the rotor of the potentiometer feeding the primary of the relevant coil. Another method is to use a midget variable capacitor of about 150pF maximum, in series with the aerial lead to the coil primary. Both systems are effective and both could be tried and the one adopted which meets the need in the better way.

As we have two different approaches to the tuning of the RF Amplifier and the physical requirements are different, we will run through each one separately. Firstly, we will do the more conventional one, with the switched coils.

With the exception of the aerial attenuator, whatever type may be used, and the tuning capacitor, all components are integrated into one assembly. Most of the components are mounted on a strip of tag board, with 11 pairs of tags. The five toroidal coils are mounted on another similar size tag board. Both of these are shown in the respective sketches.

A logical place to start is winding the five toroidal coil units. This task is straightforward but a few comments may make the job a little easier. The number of turns quoted in the coil table may be considered as the number of times the wire passes through the hole in the toroid. It is a good idea to make an estimate of the quantity of wire required for the secondary and then locate the centre of the length. Pass one end through the toroid and bring the wire to the centre point, thus leaving equal amounts to be wound with half the number of turns each way. This means that there is less wire to thread through each time. Care

should be taken not to scrape the enamel from the wire against the edges of the toroid.

At one end of the secondary winding, which will become the earth end, the primary is wound on. The common earth ends of the two windings should be bared, tinned and soldered together.

The number of turns on each winding and the disposition of the windings should be closely adhered to, as given in the table. However, the gauge of wire specified is simply a guide. If you do not have the exact gauge specified, something close to it should suffice. At the same time, particularly for the higher frequency coils, the gauge of wire should be as heavy as practicable, to reduce the RF resistance of the coil and so give a higher Q.

With the five coils wound, they can be mounted on the tag board in the relative positions shown in the diagram. The respective ends of the windings are terminated at convenient adjacent tags on the board. In the case of the lower frequency coils, which are wound with relatively fine wire, this is not sufficient to fix the coil securely to the board. This is best done by simply tying the toroid to the board with a piece of nylon cord. While not so necessary with the coils wound with heavy wire, it is a good idea and ensures that they do not move about.

The main component board is next and is wired up according to the diagram. The usual care should be taken not to overheat any of the components, particularly the transistors. Make sure that all the interconnecting wires are complete before any attempt is made to take the assembly of this board any further. The three capacitors in series with the tuning capacitor are not wired in at this stage, however.

The two above sub-assemblies are mounted on the end of the range selector switch and separated from each other and the switch with ¼in long spacers. The first step in asembly involves fitting the first pair of spacers to the rear ends of the two switch retaining screws. Generally, there is about 1/16in of thread protruding beyond the nuts. The screws used in MSP switches are 5BA and the threaded spacers which are readily available are 1/8in Whitworth. These dissimilar threads do not mate very well but due to the short length of the thread, it is possible to screw the spacers on, provided due care is taken. If you can substitute Whitworth screws, so much the better.

Having mounted the spacers, check the centre-to-centre dimension between the spacers with that of the third hole from each end of the two boards. More than likely you will find that the two holes are too close together. A little filing with a small round file will put this right.

The board with the coils is mounted against the spacers at the end of the switch, with the coils away from the switch. The second board is spaced away from the coil board with the second pair of ¼in spacers. Two round-head screws, 1/8in x ¼in are used to secure the two boards to the spacers on the switch.

The assembly is now ready for the outstanding wiring and components. The various sections of the switch are used as follows: One section of the wafer nearest the clicker plate is used

to switch the aerial into the primaries of the coils. The corresponding section on the other wafer (nearest the line of transistors) switches the tuning capacitor to the relevant series capacitors. The other section of the same wafer selects the top of the secondary of each coil. Finally, the otherwise spare section of the wafer nearest the clicker plate is used to short-circuit certain coils as required. This should be wired carefully, as mistakes are easy to make here.

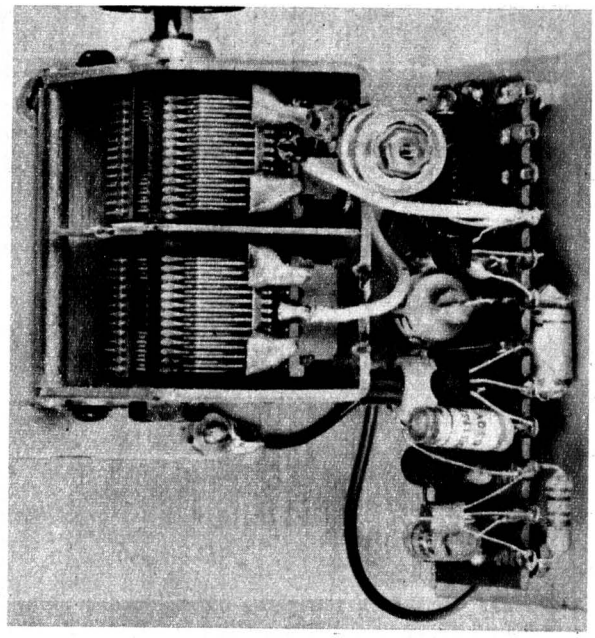
The wiring involves the interconnections between the various contacts on the switch and coils, together with the series tuning and aerial capacitors. The latter capacitors are wired with a very short lead, to anchor them closely to the lugs on the switch. The other leads up to the coil board will need to be fairly long and these should be run directly and with the use of some nylex tubing for insulation where necessary.

This almost completes the assembly, but we must bring the tuning capacitor into the picture. The final choice is up to the builder but, for the sake of convenience in presentation, we made up the final assembly on a small "U" shaped bracket, similar to the way it would be assembled on a chassis. The complete unit is shown in the photograph. We have not accommodated the aerial attenuator on this assembly, but readers again will be able to decide the best place for this on individual merits.

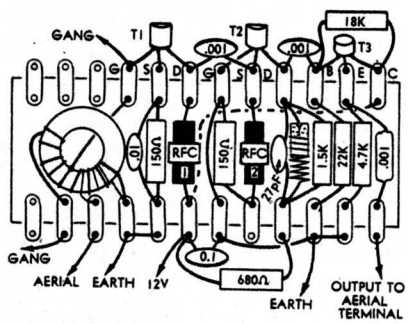
For those readers who choose to make up the multiple tuner version of the RF amplifier, here are some comments which we hope will be of assistance. Looking at the main circuit and replacing the inset giving the multiple tuner details, you will see that it is much simpler. The earlier comments relating to the aerial attenuator still apply as do all other comments on the rest of the circuit, except the coils and switching.

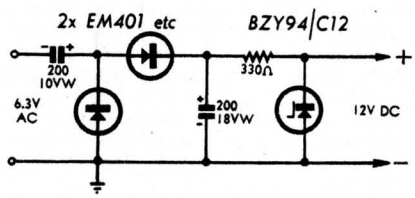
Instead of the overall assembly centred around the switch, we have a slightly modified wiring board, similar

At right is a view showing the way we laid out the muliple tuned version of the amplifier. Care should be taken to ensure that interconnecting leads are kept as short as possible.

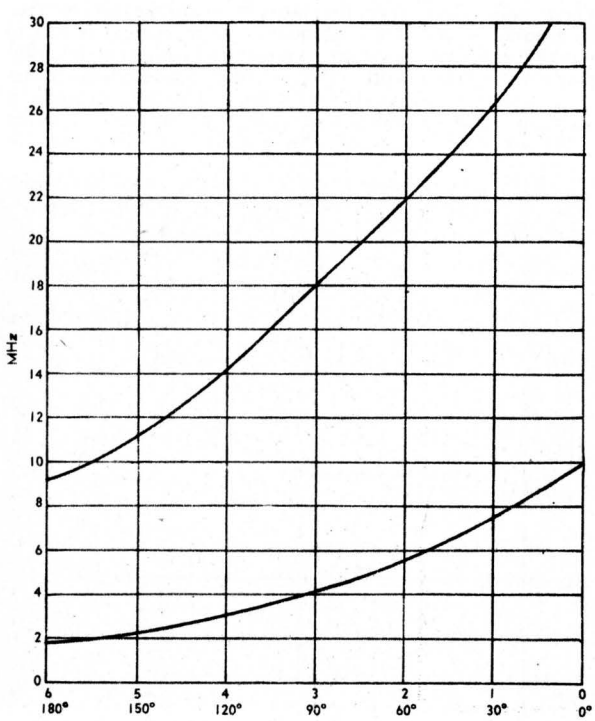


Below is the wiring diagram showing how we wired the board for the multiple tuned version. It is substantially the same as the component board for the switched coil version.





This circuit may be used to power the RF amplifier from a source of 6.3 volts AC, such as the heater supply of an existing receiver.



The graph at left shows how the multiple tuned circuit tunes to two frequencies at any one time. Duplicated amplifiers by readers may not coincide exactly with these curves but they should be a close approximation.

to the amplifier board for the other unit, but extended in length to 12 pairs of tags. It will also be noted from the wiring diagram for this board that the special transistor and components for the AGC transitor have been omitted. This will normally be the case for the other board, unless readers wish to use the AGC system. The resulting extra length of board is sufficient to accommodate the one coil needed.

Details for the above coil are given in the coil table and this should be wound first, with the previous comments applying. In addition to the primary and secondary windings as before, the secondary is tapped at eight turns from the earth end.

Next, the board should be wired up as shown in the diagram, care being taken as with the other one, that components should not be overheated. With this wiring completed, the coil can be fitted and if thought desirable it may be held in place with a tie of nylon cord.

As mentioned much earlier, the multiple tuner requires a 2-gang capacitor. It will also be noted from the circuit that the section of the gang across the tapped part of the coil is shunted with a 3-30pF variable trimmer. This is fitted to restrict the upper tuning limit to a little above 30MHz.

Rather similar to the previous case, the wiring board and the 2-gang capacitor are finally assembled on an "L" shaped bracket, as shown in the photograph. The capacitor stands on the horizontal part, with the wiring board screwed to the vertical part.

When mounting the wiring board, it is necessary to stand it off the bracket by ¼in to ½in, to allow sufficient clearance for wiring soldered joints and any protruding components. This can be done simply by using screws of appropriate length and using extra nuts so that the amount of clearance is achieved.

This completes the description of the two versions of the RF Amplifier but it is still necessary to provide a source of a minimum of 9 volts and preferably 12 volts D.C. as a power supply. This can be met quite readily with a battery

(Continued on page 190)

PARTICLE DETECTORS—

In last month's issue, the author discussed particle accelerators and explained how they are used to investigate the structure of atoms and even more elementary particles. This month the devices used to watch the various manifestations produced in particle experiments will be described — the means by which some of the events taking place in the invisible world of the atom can be presented in visible form.

By L. C. Debnam

The particles involved in nuclear or atomic experiments are extremely small and this can pose problems in seeing what occurs at this level. A proton, the nucleus of a hydrogen atom, has a radius of approximately 10^{-12} cm and electrons are even smaller. The wavelength of visible light is about 5 x 10^{-5} cm, i.e. about 200 million times the diameter of a proton, so that light cannot be used for viewing the interior of atoms, and most detection methods are of a secondary rather than direct nature.

The earliest detector of atomic particles was invented before such particles were known to exist. This is the photographic plate. In 1896 Henri Becquerel discovered that natural uranium would fog a photographic plate even though the plate was protected with black paper. It was later shown that this was caused by electrons and gamma radiation from the radioactive decay of the uranium.

A photographic film or plate consists of an emulsion of silver bromide (AgBr) crystals mounted on a transparent support such as glass or film. Various chemical agents such as Ag_2S (silver sulphide) are used to make the emulsion more sensitive to light, and sometimes other silver halides such as AgCl (silver chloride) or AgI (silver diode) are used as the main sensitive agents.

Silver bromide, as a compound, is formed by the silver atom contributing an electron to the bromine atom, so that the silver atom becomes positively charged and the bromine atom becomes negatively charged. When a quantum of light strikes a bromine atom in AgBr it displaces the extra electron, thus converting the bromine atom to its normal uncharged form. In this form it can combine with another such bromine atom to form a bromine molecule, Br_2, which evaporates from the emulsion. The spare electron may then be recaptured, during development, by the positively charged silver atom left behind, to form metallic silver, leaving a dark mark in the film where the light has struck.

When used for atomic particle detection the electron is displaced from the bromine atom by the particle which strikes the film instead of light, the end result being that a dark spot appears.

The photographic process of particle detection is often unsatisfactory unless many particles are present to be detected. Almost any particle will displace the electron from the bromine if it passes close enough, but due to their small size many particles pass through the film without coming near the bromine atoms. To partially overcome this problem special films with thick emulsions are made for particle detection purposes, as a thick emulsion increases the chances of a particle displacing an electron.

As any particle or quantum of radiation with sufficient energy may displace the electron, photographic techniques are insufficient by themselves to determine the type of particle or radiation involved.

Historically, the next type of particle detector developed was the ionisation chamber. In its basic form this consists of a pair of metal plates connected to a battery, as illustrated in figure 1.

As the speeds of particles emitted in radioactive disintegration are usually high they have sufficient energy to dislodge loosely bound electrons from normal air atoms, giving the atoms a net positive charge. Such atoms are known as "positive ions."

Normally the positive ions and free electrons caused by such a process in air are attracted toward each other and rejoin to form neutral atoms. In the ionisation chamber, however, the positive ions and electrons are under the influence of another electric field, that supplied by the battery. This results in a movement of the electrons toward the positive plate and of positive ions toward the negative plate, which in turn causes a current flow in the external circuit. The battery supplies electrons to neutralise the positive ions, and the resulting air atoms drift away from the plate. As current flows in the external circuit only when the air is ionised, and the air is ionised only in the presence of high-speed particles or intense radiation, a current flow indicates the presence of such particles or radiation.

In some cases the particles entering an ionisation chamber lose all, or almost all, of their energy in collision with the air molecules, and as they are generally charged they also are attracted toward one of the plates, contributing further to the current flow.

If the voltage applied to the plates of an ionisation chamber under constant particle bombardment is increased, the current increases linearly for a while, and then becomes steady as saturation is reached, i.e., until all ions are attracted to the plates. This is illustrated in the graph of figure 2.

When the voltage is increased further the current again begins to rise. This secondary rise in current is due to a process known as "ionisation by collision." With a high accelerating potential between the plates the ionised air atoms can attain high speeds in moving toward the plates, and this can be

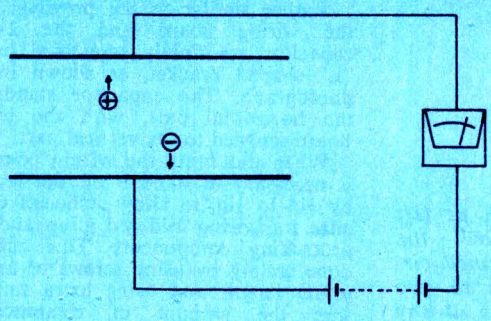


Figure 1. An ionisation chamber has two metal plates connected to a battery and ammeter. When air between the plates is ionised, the charged particles are attracted to the plates and current flows.

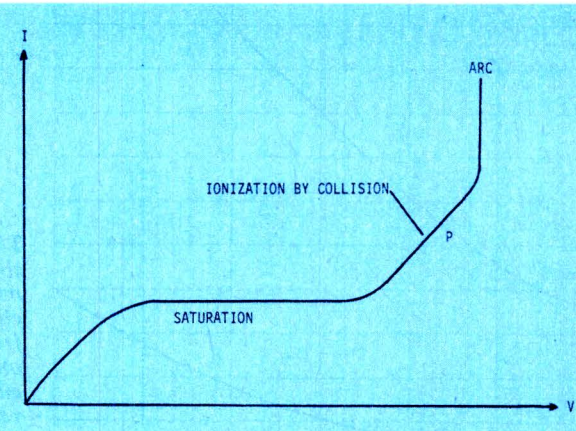


Figure 2. Increase of ionisation current with voltage.

they count the invisible

sufficient for the moving ions to dislodge electrons from other air atoms, thus creating more ions, which may in turn produce more ions in a cascade or "runaway" process. If the voltage is sufficiently increased, sparking will occur between the electrodes.

Two other types of detectors, the proportional detector and the Geiger-Muller tube utilise the region of ionisation by collision for greater sensitivity in particle detection. These instruments are usually in the form of a metal cylinder with a fine wire down the axis, the whole enclosed in an airtight glass container. The glass container is usually filled with a gas, such as argon, at a pressure of about 1000Pa (1/100th of an atmosphere). A high voltage is connected between the wire and the cylinder, the positive connection to the central wire.

In the proportional counter an accelerating potential is applied such that the tube operates on a straight part of the graph where ionisation by collision occurs, such as point P in figure 2.

At this point on the operation curve the amount of secondary ionisation that occurs is proportional to the primary ionisation, and is thus referred to as the **proportional region.**

Charged particles such as electrons, protons and alpha particles (helium nuclei), produce much more intense initial ionisation than gamma radiation or X-rays, and as the gas amplification (or ratio of secondary ionisation to primary ionisation) may be as high as 10,000 the differences between current pulses produced by charged particles and radiation will be correspondingly large.

The current pulses from the proportional counter tube are amplified electronically, and as the pulses from particles are larger than the pulses obtained from radiation the first stage of the amplifier may be biased to count only the larger pulses. In this way counts of alpha particles or beta particles (electrons) may be obtained even in the presence of gamma radiation. When used as a Geiger counter the tube is operated at a potential slightly less than the arcing voltage, so that when a discharge is initiated by a particle or ionising radiation passing through the tube the current rises quickly to a high value.

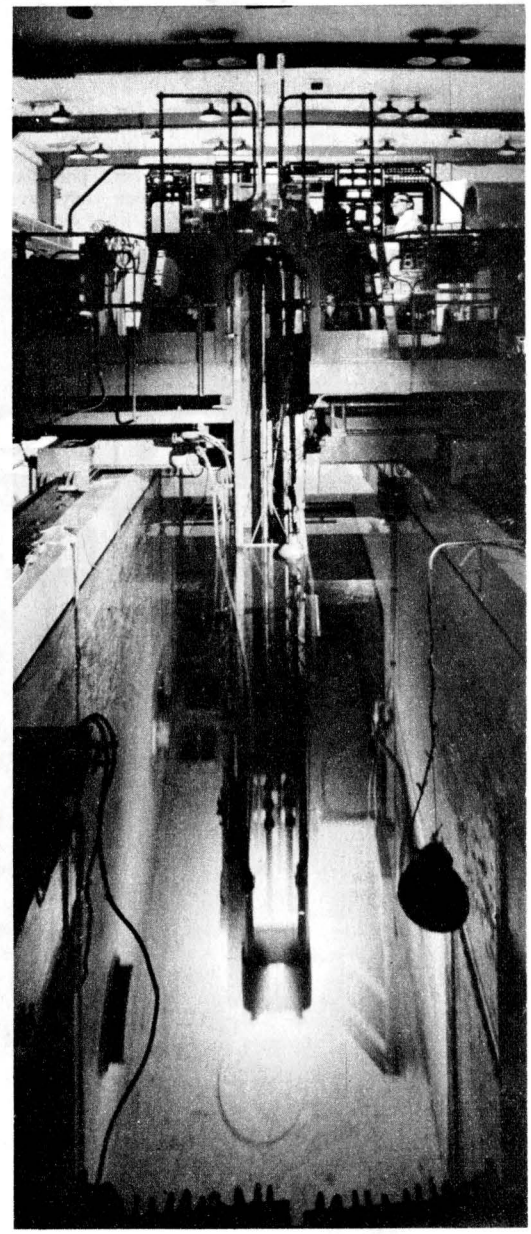
To prevent the discharge from continuing indefinitely the voltage to the tube is supplied via a resistor, which reduces the applied voltage as soon as the current rises, and an arc cannot be maintained.

The main objection to the Geiger counter in this form is that the impact of positive ions on the outer cylinder can cause secondary emission of electrons. This action tends to prolong the original discharge and, although this will be quenched eventually by the action of the series resistor, the time constant formed by this resistor and the capacitance of the tube electrodes allows it to continue for a relatively long period — of the order of a millisecond or more. This period is called "dead time," because any particles which enter the tube during this period cannot be counted.

The "deadtime" of the tube may be reduced by adding about 10 per cent of a polyatomic gas, such as ethyl alcohol, to the argon. This suppresses the secondary electron emission which results mainly from the ultra-violet radiation given off when the positive ions are neutralised at the outer electrode. With this gas addition, the dead-time of the tube is limited to the time required for the positive ions to move to the outer cylinder — 100 to 200 microseconds.

The pulses from a tube used as a Geiger counter are relatively large, as the gas amplification may be a million or greater, and less sensitive amplifiers are required than for the proportional counter.

A modern variation of the ionisation chamber is the solid state radiation detector. In the same way that light may activate a PN junction, gamma radiation or a charged particle may cause ionization and conduction. This is more sensitive than the classic ionisation chamber, because the density of the material (number of detector atoms per



The glow seen here in the water tank of Britain's LIDO "swimming pool" type research reactor is Cerenkov radiation emitted by the reactor core.

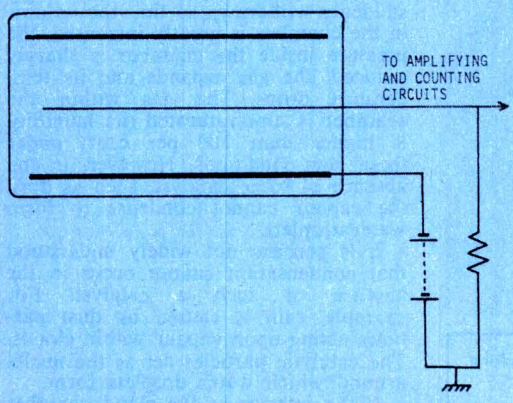


Figure 3. The Geiger-Muller tubes and associated circuits.

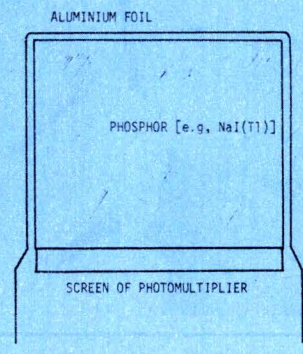


Figure 4. The scintillation counter.

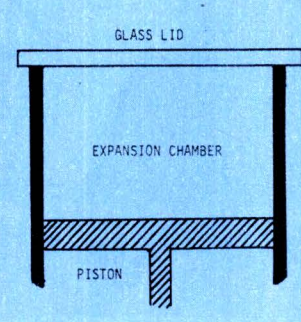


Figure 5. The Wilson cloud chamber.

given volume) is much greater than the density of a gas.

An early technique for counting alpha particles used a thin zinc sulphide screen, as on cathode-ray tubes. When alpha particles or beta particles strike a zinc sulphide screen they give up their kinetic energy as light flashes. Detection was achieved by placing the screen near a source of such particles in a dark room and counting the number of light flashes.

As well as promoting eye strain, this was dangerous to the operator, as gamma radiation usually accompanies beta emission. The method has now been modernised into the scintillation counter.

The scintillation counter consists of a phosphor (i.e. a substance such as zinc sulphide capable of producing light when struck by a particle) mounted at the end of a photomultiplier tube. The light coming from the scintillation produced in the phosphor by the particle strikes the photocathode of the photomultiplier and produces one or more photo electrons. The action of the photomultiplier then increases the electron flow by a million or more, and this may be further amplified by suitable electronic circuits.

Although a thin zinc sulphide screen is suitable for detecting large particles such as alpha particles, thick phosphors are required to detect more penetrating particles and radiation. These phosphors must be transparent so that the scintillations will reach the photomultiplier.

As the light produced can travel in all directions the phosphor is usually covered with a thin layer of aluminium, except for the face near the photocathode. The aluminium reflects the light to the photocathode and ensures a count. At the same time, if the aluminium is thin, it does not impede the passage of any particles except the extremely slow ones.

Many organic materials, both solid and liquid, have proved useful as phosphors. Among these are anthracene, naphthalene and stilbene. Some inorganic substances have also been used. Zinc sulphide was the earliest used but most scintillation detectors have sodium iodide crystals or potassium iodide crystals with the addition of thallium as an activator.

As well as the properties mentioned earlier, the usefulness of a phosphor depends on the duration of the light pulse produced. This is usually of the order of 10^{-8} second so that many scintillations can be counted in a short time.

The types of particle detectors discussed so far are used to detect the presence of particles, but are generally unsuitable for tracking the movement of a particle.

The Wilson cloud chamber is illustrated in figure 5. It consists of a cylinder and piston, the closed end of the cylinder being glass so that the interior of the chamber can be seen. Inside the chamber is a gas with a high percentage of humidity. If the piston is suddenly withdrawn so that the volume in the chamber is greatly increased, the pressure inside the chamber is sharply reduced, the gas expands and its temperature drops. The gas within the chamber is supersaturated (its humidity is higher than 100 per cent) under these new conditions. However, in the absence of some catalyst, such as dust, the vapour cannot condense to form water droplets.

It is perhaps not widely understood that condensation cannot occur in the absence of such a catalyst. For example, rain is caused by dust particles acting upon vapour within clouds. The catalytic particles act as the nuclei around which water droplets form.

If the interior of the cloud chamber is free of dust or other catalystic particles, the vapour cannot readily condense, even though it is supersaturated. However, when ionising particles are

moving through the chamber, they ionise gas atoms, and these can act as points where condensation can occur. The result is a misty trail indicating where the particle has moved. By illuminating the chamber, the fog trails may be readily observed and photographed. If the chamber is placed in a magnetic field the incident charged particle does not follow a straight path, and from its motion its momentum may be calculated if the charge is known.

In 1952 Donald Glaser, an American physicist, devised a variation of the cloud chamber which he called the bubble chamber. In this, a liquid is maintained under pressure at a temperature just below its boiling point. When it is desired to observe the passage of particles, the pressure is reduced so that the liquid is above its boiling point for that pressure. As in the case of the cloud chamber, the ions formed by the passing of particles act as a catalyst, but whereas in the cloud chamber they cause the formation of water droplets, in the bubble chamber they cause the formation of bubbles.

As the density of the liquid is several hundred times the density of the gas used in cloud chambers, the number of ions produced in a bubble chamber is much greater than in the cloud chamber. A bubble chamber 6in diameter is equivalent to a cloud chamber of 142ft diameter. Tracks of mesons are readily observed in the bubble chamber, but are extremely rare in the cloud chamber.

A more complex method of detecting extremely high speed particles is the use of Cerenkov radiation. It is generally known that when an object moves faster than sound a shock-wave is set up. Cerenkov radiation is effectively a shock wave of light, caused when an object travels faster than light. This phenomenon can only be observed in a material medium where the speed of light is less than the speed of light in a vacuum.

For example the speed of light in water is about 225,000KM/sec. (140,000 miles/sec) and beta particles (electrons) emitted from many radioactive materials exceed this speed.

Cerenkov radiation may be seen as a violet glow in water when highly radioactive materials are stored there. (See picture, page 89.)

The path and speed of a particle may also be determined, as the radiation is emitted at an angle θ given by

$$\cos \theta = \frac{v}{u}$$

where v is the speed of light in the particular medium used and u is the speed of the particle.

All atoms are mainly empty space, and to ionize an atom an electron is removed or inserted. To remove an electron, as in ionisation methods of particle detection, a force must be applied to the electron. If the particle to be detected is electrically charged it can cause ionisation by passing the atomic electron, as electrical forces can act at a distance. However if the particle to be detected is uncharged it would have to directly hit the electron to remove it from the atom, and the chances of this occurring are extremely small. For this reason neutrons and neutrinos are almost undetectable by the methods discussed so far, and secondary methods are required.

One of the most common secondary methods is to coat the inside wall of a gas chamber (ion chamber or Geiger tube) with boron trifluoride (BF_3). When a neutron strikes this, it converts the boron to lithium and releases an alpha particle which is detected by the ionisation it produces. Other similar methods utilise uranium as the "conversion" material.

A variation is to make the "window" of the Geiger tube from a hydrogenous substance such as paraffin, which emits

(Continued on page 189)

FORUM

Readers: FM should be on the VHF band

The announcement by the Postmaster-General, Mr A. S. Hulme, of an inquiry into FM broadcasting in Australia (see last month's editorial) has triggered a certain amount of correspondence — though not as much as one might have expected. We quote some typical comments by readers.

Conducted by the Editor

One such comment comes from G.W., of Hobart. He says:

"I note that the P.M.G. is again considering the introduction, after far too many years, of FM transmissions. I sincerely hope you will be a strong advocate of it. A considerable number of receivers must be in use at present, within the 88-108MHz band, and it would be a good move to have the FM broadcasts reintroduced on this band, as well as on the UHF band."

G.W. expresses the hope that "Electronics Australia" will be a strong advocate of frequency modulation broadcasting. On this score, he need have no fear. Frequency modulation offers the only tangible hope in sight for high quality, noise-free broadcasting and, beyond that, stereo broadcasting and even continuous music on a subscription basis. Such developments are completely in line with our traditional promotion of high quality audio — a promotion that we believe has played a major part in the very wide popularity of high quality disc and tape reproducing systems.

Unfortunately, in our comments on FEM broadcasting, we have so often found ourselves having to counter unrealistic ideas that we seem to be opposing the proponents of the system rather than being on their side.

Whether we like it or not, the facts of life are that the major decisions regarding FM were taken at a time when the electronics industry and the public generally were almost completely preoccupied with television. We needed more space for television and other VHF services; we didn't want to get involved in a dual VHF/UHF television system, and the FM band was sacrificed.

A few mourned the passing of the experimental FM services, but it is only with the run-down of television interest that the industry has begun to remember the little-mourned corpse in our electronic graveyard.

Letters like the one quoted above reflect the fond hope that the proposed inquiry will re-establish an FM service in the 88-108MHz band or in such portions of it as might be available in various districts.

I doubt very much whether the Australian Broadcasting Control Board will go along with the idea of FM stations dropped in among television stations, wherever they happened to fit, particularly if the "left-overs" had to be shunted up to the UHF band.

Proponents of this scheme tend to work out little sums which seem to indicate that so many FM stations could be fitted into such and such a space, but it isn't as simple as that. A lot of other, more elaborate sums have to be done, to resolve possible problems of interference involving, among other things, the spurious responses of practical receivers.

As I see it, the only real course for an integrated FM service with the 88-108MHz band would involve a reversal of the earlier decision and elimination of one or more of the present TV channels 3, 4 and 5, all of which trangress into the traditional FM band. Such a step could certainly not be taken lightly or without a lot of protest from the stations and viewers involved.

The idea of frequencies shared between TV and FM is put forward by another reader. He voices an extra request, but more of that later. We quote:

"Dear Sir,

"With renewed official interest in the future of FM broadcasting in Australia, as indicated by the Postmaster-General's request for an inquiry to be held by the Australian Broadcasting Control Board, this would seem an opportune moment for you to publish details of transistorized circuits for an FM tuner, perhaps with stereo decoder, suitable for amateur construction. Such a tuner is on sale in the U.K. for about £7 and the major problem for a constructor here would probably be the design and alignment of the IF transformers.

"With regard to the feasibility of FM broadcasting, given the present allocation of usable frequencies to television interests, I see no reason why Channels 3 and 4 could not be shared. The nearest TV stations to Sydney, Melbourne and Adelaide on either of these Channels are at Wollongong, Eilden and Spencer Gulf Nth. and, since both television and FM have effectively line-of-sight reception, there would be little interference between them. Furthermore, where the common channel television transmitter operated with horizontal polarisation the FM station could ultilize vertical polarisatoin, and vice-versa.

"Judging from recent correspondence to the editors of "The Australian" and "The Sydney Morning Herald" there exists a good deal of public interest in the introduction of high fidelity sound broadcasting, evidently sufficient to justify the institution of an official inquiry.

"As editor of the most widely read electronics journal you may like to comment in an editorial.

L.J. (French's Forest)."

The point I take from this letter is not so much the idea of channel sharing, which has already been mentioned, but the implicit assumptions that:

1. The Inquiry will recommend the immediate adoption of an FM broadcasting system.

2. It will recommend FM/Stereo.

3. The service will be in the usual VHF band and conform to standards currently used overseas.

4. The Federal Government will implement the recommendations forthwith, justifying our publication of circuits and designs for appropriate equipment, so that readers can start building.

Here again, we seem to be applying a damper but it is much too early to jump to any of these conclusions.

The Inquiry may or may not recommend the establishment of an FM or FM/Stereo service.

It may or may not favour the VHF band, with all the difficult implications we have mentioned.

It may or may not recommend adopting overseas standards as a package, particularly if another frequency band is favoured.

And, last but not least, the Government may or may not act upon any of the recommendations.

Whatever the outcome of the inquiry and whatever is the Government's reaction to its report, an FM broadcasting service will not happen overnight. Almost certainly there will be a target

date to serve the interests of both the potential broadcasters and the potential audience and the announcement of this target date will be time enough to start worrying about principles and projects.

To encourage readers, now, to spend money on equipment of any kind would be to invite mass criticism that we have merely led them up the garden path!

A third letter which I quote, comes from a reader in Eltham, Victoria. He, too, is convinced that an FM service should be established on the frequency band originally set aside for it but his case rests on a different approach. We quote:

"Dear Sir,

"The recent announcement by the Postmaster General that the ABCB would have a look at various aspects of FM broadcasting, has probably revitalised the activities of adherents to the faith.

"Whilst the scope or terms of reference are not known to me, one or two observations can be made that may have some bearing on the question, especially in regard to the long-term development of the proposed service.

"As you are doubtless aware, the ITU Space Services conference will, in 1971, consider allocations in the VHF, UHF spectrum, and, depending on the proposals made by administrations, come up with some resolutions.

"It may not be generally known that a part of the original U.S.A. proposal for this conference, is to seek world-wide agreement to the use of 88-108 Mhz for satellite FM broadcasting. Let me emphasise at this stage that the proposal is a preliminary one and may not get off the ground; but let us stay with the idea.

"The idea stems, of course, from an earlier proposal that direct satellite TV transmissions be made to augmented or unaugmented domestic receivers, but this was deemed not to be feasible at this time. In the interim FM satellite broadcasting as a more simple exercise should pave the way for a more sophisticated (?) entertainment medium.

"Now the whole point of the argument is this: the concept of FM satellite broadcasting is immediately lifted from the lobbies of parochialism to those with a more international flavour, and at the same time, it is conceivable on an intergovernmental shared cost basis, that establishment costs would be more than favourable when compared with the earlier terrestrial transmitters with their limited coverage; this latter point was used, if I recall correctly, as an argument against the introduction of FM.

"It is to be hoped that these aspects will be covered in the forthcoming inquiry and, although the part of the spectrum planned provides problems for Australia, there are alternatives. The general idea, on the face of it, has merit, and could well be supported by both Government and commercial broadcasters alike.

"If the general public want FM (as well as the industry) now is the time to establish the best long-term concept within the framework of space communications. Precedent is, or is being, set in the fields of outback communication by the Post Office by means of a satellite, with the Maritime mobile services also getting into the act. There appears to be no valid reason for FM transmissions not to develop in a similar way."

P.D. (Eltham, Vic.)"

And there, I imagine, we can leave the subject of FM broadcasting for this issue.

Changing the subject, I suggest that you read the letter on this page from a correspondent in Launceston. He introduces himself as a reader whose home-building activities extend back to the early thirties, when the foundations of the journal were being laid by an earlier generation of technical writers.

It is good to know that readers from this era are still with us, having surmounted the tremendous changes which have occurred in the industry, from large to miniature components, from valves to transistors, from transistors to integrated circuits, from a components approach to a module approach.

And yet, at the other extreme, we have young readers who have been brought up on transistors and integrated circuits and to whom the language of electronics is the language of solid-state. To them, valves are rather puzzling, cumbersome devices, which they need to read about, belatedly in order to round out their knowledge!

We would thank T.C. for his remarks, knowing that he represents a still quite substantial group of readers, who write to us from time to time and for one reason or another. The immediate points of his letter, however, are the comments about importing components.

We have included his remarks about the advertiser from Hong Kong, as much as anything because they balance out what might have been construed as criticism in the earlier issue. Never having been through the exercise, we have no opinion about the advantages or disadvantages of purchasing components in this way. If components happen to come through without duty and are exactly in line with requirements, they would almost certainly represent a bargain. But if they attracted duty and happened to be unsuitable in some cases for local circuits, the economy of the operation might be open to question.

As for his remarks about receivers for $8.95, I think the appropriate line is one that has become quite commonplace recently: "Funny you should mention that!"

Following publication of the letter from T.C. in the May issue, a member of our staff made the point that he had seen apparently similar receivers offered in a SYDNEY Department store for about the same figure. In fact, he asked much the same question as R.K. has raised. Where did the surcharge and duty get to?

Someone else, who noticed the anomoly, suggested that the receivers may have been a batch seized by customs and later auctioned off. If so, it must have been quite a batch to justify clearance through at least two major department stores!

In saying this, we are not seeking to take sides on the subject of surcharge and duty. This is part of a much bigger question which affects the viability of our local electronics industry and it would have to be examined from this national viewpoint. We are simply raising the question as to how regulations would appear to have worked differently for a private individual on the one hand, and major departmental stores on the other.

The explanation is one we would like to hear. ■

$8.95! How come?

Dear Sir,

I have been a reader of your magazine and "Wireless Weekly" since the "1933 Standard" and the "1934 Champion," both of which I built with good results. I feel that I should express thanks for the pleasure I have had in reading your magazine and the instruction it has given.

I am impelled to write at this moment because of the letter from T.C. of Numurkah, published in Forum in the May issue.

I have placed several orders with the Hong Kong firm mentioned and have found them strictly honest, although some of the merchandise offered is obviously manufacturers' surplus.

I ordered two transistor portable radio kits and was asked to pay $34 duty. I refused and asked the Customs to return the radios to sender. The firm supplied me with radio parts to the value of the receivers, which I considered good value, even after paying 45 per cent duty and 25 per cent sales-tax.

What puzzles me, however, is that I recently purchased a small 6-transistor radio from a large department store in Melbourne for $8.95. It was a very modern design but using all Asian parts. Since it has no patent royalty sticker, I assume that it is also of Asian manufacture.

How can this be, if the set should have attracted an automatic $10 surcharge, plus 45 per cent duty? (R.K., Launceston.)

DC Amplifier from a Low-Cost Digital IC

A low cost digital microcircuit such as the Fairchild FuL914 may be used as a linear DC amplifier. A useful application of this idea allows the effective sensitivity of a 1mA meter movement to be increased to better than 50uA.

by LEO SIMPSON

Virtually the only method by which an existing 1mA meter movement can be increased in sensitivity is to use an amplifier. The circuit presented here is perhaps the simplest and most economical method of providing a suitable amplifier. The resulting meter-cum-amplifier should be suitable in most applications as a direct replacement for a high sensitivity meter movement. The resulting sensitivity will be considerably better than 50uA F.S.D. (Full Scale Deflection), and it is an easy matter to adjust the sensitivity to any required figure above this by shunting the input.

Referring to figure 1 which shows the internal circuitry of the FuL914 microcircuit, and figure 2 which shows the external circuitry, it may be seen that only one transistor of each of the two internal pairs is used. The unused transistors are "cut off" by connecting their inputs to pin 4 which is the common emitter connection for all four transistors.

The 3.3 volt zener diode and common 470 ohm emitter load resistor establish the bias condition for the amplifier. Balance conditions (i.e., zero voltage across the meter) are obtained by setting the 1K potentiometer so that the voltage drop across the collector resistor of T1 is equal to the voltage drop across the collector resistor of T3. Thus, T1 and T3 constitute a "balanced bridge" or "long-tailed pair" differential DC amplifier. While the actual relationship between input voltage and resulting meter current is quite complex, and a good deal of space could be taken in analysis, using typical FuL914 IC's the current sensitivity of a normal 1mA/100mV meter is effectively increased by a factor of approximately 50.

There are three advantages in using the microcircuit instead of two equivalent discrete transistors. Firstly, the microcircuit is likely to be cheaper. Secondly, since the device has four transistors, there is good chance of picking two transistors which are closely matched electrically, out of the four possible combinations. And thirdly, since the transistors are all on the same minute silicon chip, problems of differential temperature drift should be minimised.

Since the microcircuit is a logic type, the internal transistors are switching types and thus it may be thought that the resulting linearity of the meter-cum-amplifier might be poor. In actual fact, this is not likely to be a problem since the transistors handle only a very small current "swing." In practice, we found the linearity to be very good.

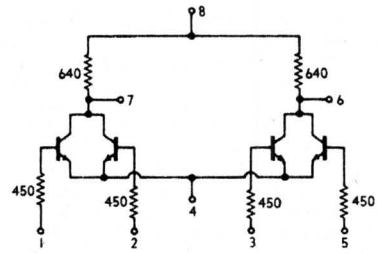
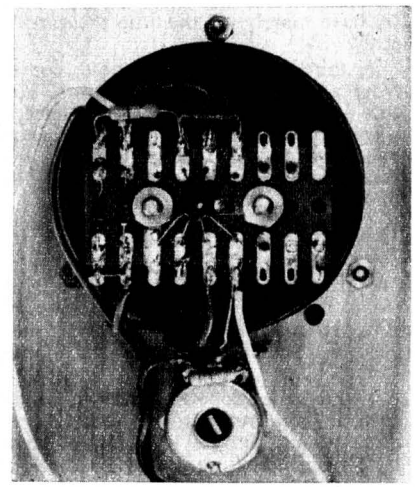


Figure 1 FuL914 CIRCUITRY



At top right is the layout of the DC amplifier on the back of a meter movement. At right is the complete circuit, showing the few parts needed to make up the amplifier.

FuL914 BZY88/C3V3

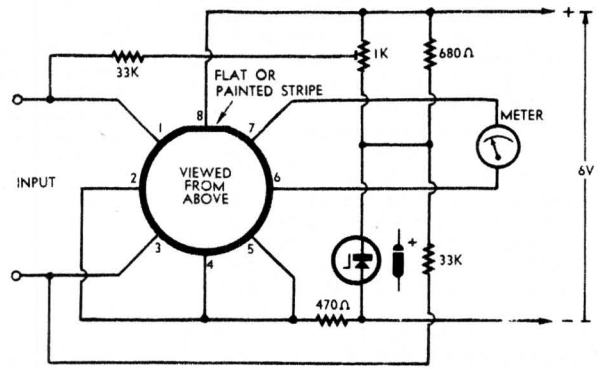


Figure 2 SIMPLE METER DC AMPLIFIER 7/MS/5

Certainly, any non-linearity contributed by the amplifier is likely to be small compared with the typical non-linearity of the meter movement itself.

Note that since the collector resistors are 640 ohms and the emitter resistor is 470 ohms, the maximum current that can pass through the meter is 6mA. This would happen with one transistor "cut-off" and the other saturated. This means that the maximum overload that can occur is six times, a factor that most movements can survive quite well. Really severe over-loads might damage the IC but the meter would be protected.

The performance we obtained using a number of FuL914 microcircuits was as follows: Sensitivity ranged from 8uA to 16uA FSD. Current drain is approximately 10 to 11mA. Change in zero setting with a change in supply voltage of plus or minus 1 volt was typically less than 2 per cent of FSD.

The bias conditions may also be varied with the potentiometer to enable the meter to be converted to a "centre-reading" unit. However, in this condition, the stability of the zero setting with change in supply voltage will not be as good. This problem could be overcome by using a 6 volt zener diode to stabilise the supply voltage. However, to fit such a diode would result in increased current drain, which may be a problem in battery operated equipment.

The circuitry can be constructed on a suitable length of miniature tagboard which can then be conveniently mounted on the rear of the meter movement, as shown in the photograph. The preset potentiometer should have a screwdriver access hole on the front panel of the equipment in which the meter is used. In battery equipment, a supply switch may also be required.

When the unit is first switched on it may be found that it is impossible to set the potentiometer for zero deflection of the meter. In this case, it is matter of trial and error to find the condition of balance. The first step is to change over the meter connections and the transistors' input connections to the zener diode and potentiometer. If this does not succeed then it will be necessary to choose another transistor pair out of the four combinations possible. It is probable that one pair of transistors will give noticeably better stability of zero voltage setting with change in supply voltage than the other connections. This can be tested quite simply be setting up a pair of transistors for zero meter deflection and then noting the drift in setting with small changes in supply voltage. ■

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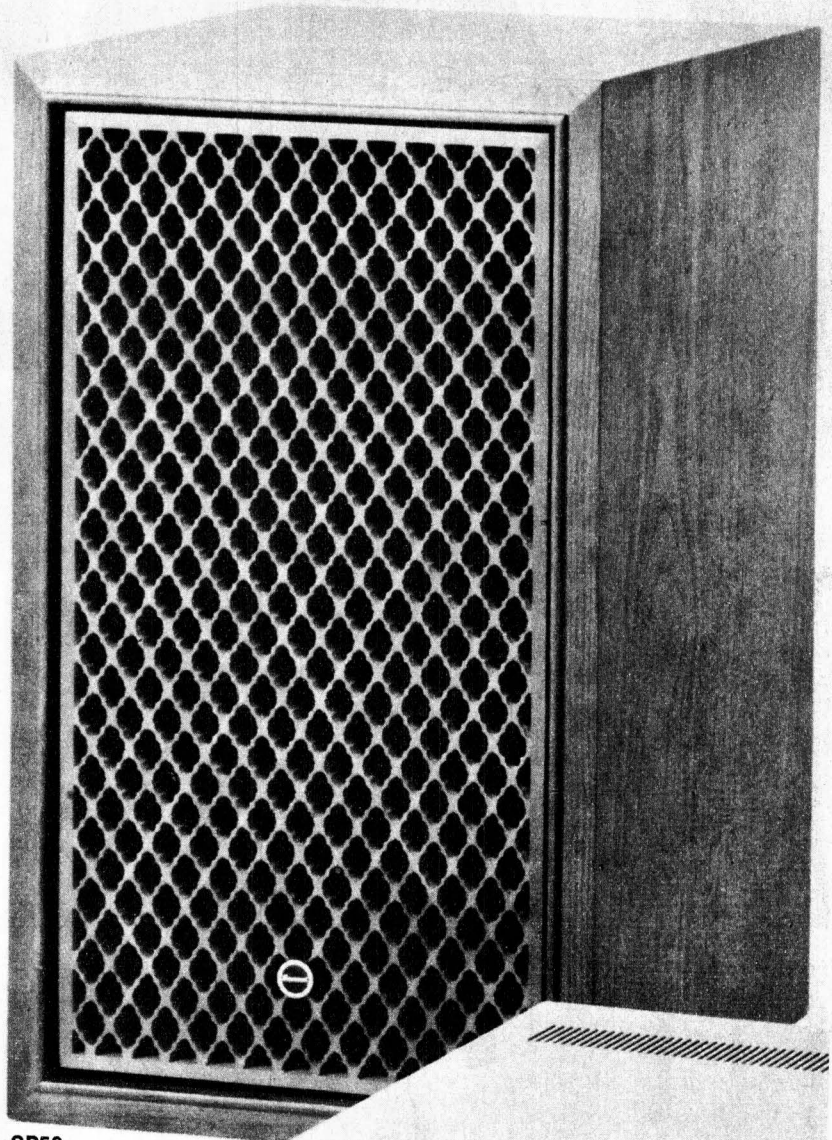

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The $1000 sound.

Just $672.

We're not suggesting there isn't a sound in the world to touch the fabulous quality of a Sansui stereo system.
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So you get a million dollar look for your thousand dollar sound.

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Using low noise silicon transistors throughout, the compact AU222 features a frequency response of 20-30,000 Hz ± 1dB, and a power output of 18 watts R.M.S./channel Input sensitivity suits magnetic cartridges at 2mV. Every desirable control is incorporated.

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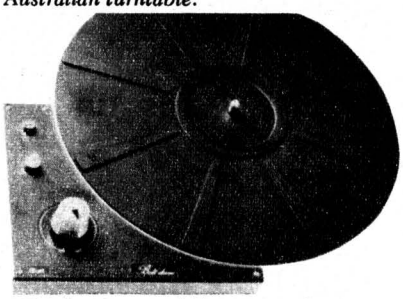
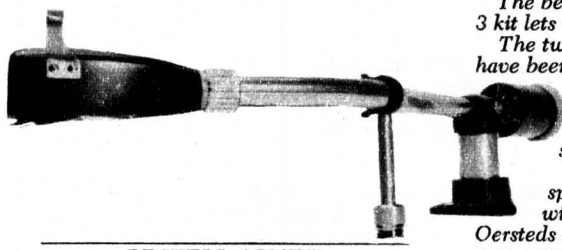
The all new precision built Australian turntable.



With a wow and flutter specification of less than 0.04% the new SILCRON two-speed turntable combines precision engineering with the proven design principle of BELT DRIVE. Substantial 12-pole sealed synchronous motor provides the motive power and ensures absolute speed control. A unique speed change mechanism permits changes from 33⅓ to 45 r.p.m. in less than one second.

Cast from aluminium, the 12" diameter turntable itself is machined to fine tolerances and dynamically balanced.

Depth required below the motor board is only ¾" and height above can be as little as 2".



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Ortofon head shell accepts any standard ½" mount. Adjustable in height to fit any turntable. Precision ball bearings for vertical and horizontal movement.

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1) Lightweight Ortofon SL 15E
Has elliptical diamond.
Moving coil system. 15° tracking angle.
High compliance cartridge.
Unique feature: Protecto-skate – additional tubing surrounding cantilever from beyond damping blocks to beyond the stylus tip.
Weight: 7 grms.
Recommended stylus pressure: ¾-1½ grms.
Frequency response 10-40,000 h.t.z.

2) S15MTE
Frequency response: 15-40,000 h.t.z.
Stylus pressure: 1-2 grms.
Built in transformer – output impedance – 15km.
Electrical cartridge protecto-skate.
Moving coil cartridge.
Channel separation – 20-30DB or better, throughout the whole range.
Tracking angle–15°.

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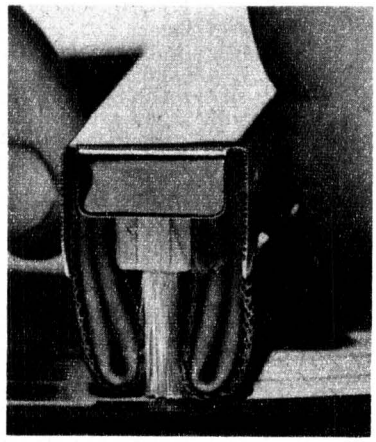
Result is a full range system suitable for direct connection to amplifiers with an output of 4-8 ohms.

All the necessary acoustic wadding, mounting bolts and connecting wire, etc., are included in the kit.



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Hand held device on moving record. Normally used before you actually start to play the record. Has plush pads on either side of nylon brush which gets right into the grooves and removes the dirt.

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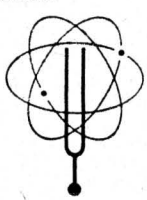
Tracks on the record, in front of the stylus and cleans record.

Removes static, reducing surface noise. Cuts down stylus wear.

N.B. (For each of the above units, you can get a fluid for reactivating the unit concerned.)



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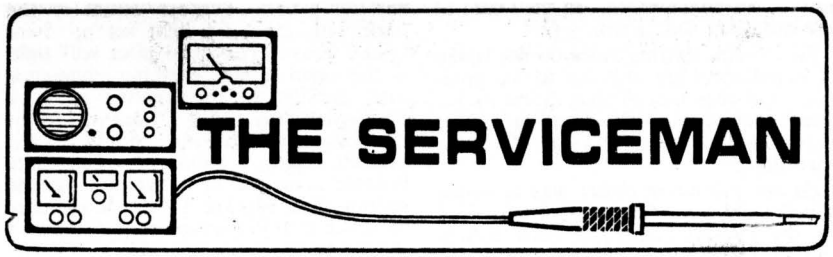


More thoughts on safety

Last month's comments about safety have prompted some letters from readers on this important subject. At the same time I encountered a nasty set-up in a domestic radio on my own service bench. Hazardous situations, it seems, are always with us.

Before discussing safety problems, here is a brief story on a quite different theme; the common problem of discharged batteries left inside an appliance — but one which produced an unusual fault. The most frequent victim of such forgetfulness is the humble pocket radio, but larger — and more expensive — sets, tape recorders, and other battery operated devices come in for their fair share. And, in view of the high cost of some of these, the damage can represent a very serious loss.

In this case it was a good quality imported three band radio; small enough to carry, yet large enough to give a good account of itself. The owner simply complained that it wouldn't work, even though he had just fitted it with new batteries.

One look inside was sufficient to show what had happened. There was a brown stain on the inside of the back of the case, and corrosion and crystals around the battery compartment. Fortunately, the main part of the set seemed to have been spared.

At first I imagined that the failure to operate was due simply to the corrosion on the battery contacts. But having cleaned these, and established that the voltage was present on them, the set still refused to work. Leaving the negative lead of the meter connected to the battery contact I shifted the positive lead to an obvious positive rail on the printed wiring board. Result: no voltage.

Must be the switch, I thought. This wasn't quite so easy to get at but I managed to get the meter prod down into the works and checked it. As far as I could make out there was nothing wrong with the switch, but it was obvious that there was no voltage on either contact. Which meant in simple terms, that the fault could be in only one place; the lead from the battery contact to the switch, about 12 inches of ordinary hookup wire.

And so, in fact, it proved to be. Somewhere in this length of wire was a break. But why? Perhaps it didn't matter, but I was curious. After all, there seemed to be no logical reason why a piece of stranded plastic covered wire, in a fixed environment, should suddenly develop an open circuit.

After I had removed it I took a closer look at it. At first I could see nothing and was on the point of tugging at either end in an attempt to pull out the shorter length and examine it. Then, about three inches from the battery compartment end I thought I detected a tiny bluish green spot.

I reached for my jeweller's glass, tucked it into my eye, and took a more critical look. My first reaction was that I had been mistaken. Under the glass it looked like nothing more serious than a spot of paint or something similar on the surface of the insulation.

To make sure I picked up a pin and probed at the plastic with the point of it. (It looked like a crowbar under the glass.) Suddenly I seemed to strike a soft patch of plastic, the point of the pin disappeared, and there was a tiny puff of blue-green powder. I peeled back a thin layer of plastic and revealed a mass of verdigris where there had once been wire.

It now seemed obvious what had happened. Apparently there had been a minor defect, such as a tiny crack or hole, in the plastic insulation. In itself, it would have been of no consequence. But when exposed to the battery chemicals it provided a point of entry. Ordinary chemical reaction did the rest.

All of which must represent some kind of a record for coincidence. Nevertheless, it should be just one more reason — if any more are necessary — why people need to exercise a little care and commonsense in looking after their battery operated equipment.

And here are the comments on the safety issue.

First, a humble mantel set which I handled during the month. It was of obscure vintage, but carried a well known brand. The fault I was required to fix was quite routine but a point worthy of comment was the power cord and its termination. As can be clearly seen in the photograph the power cord — the usual length of figure 8 flex — was knotted just inside the chassis, then divided.

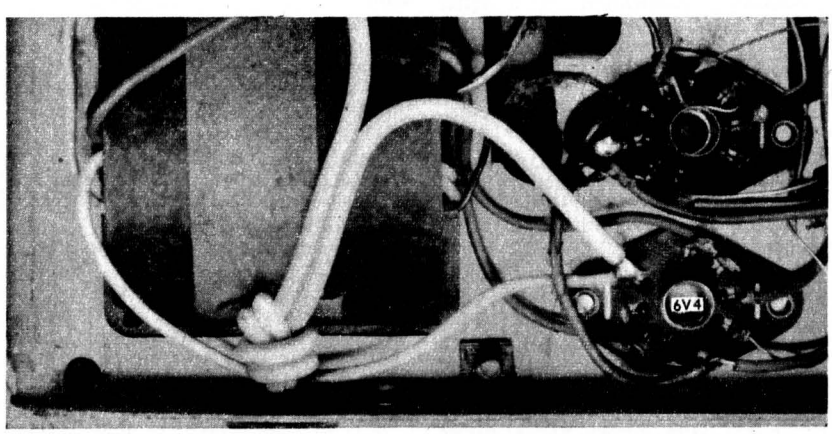
One lead, which we hope would always be the active, went to the switch on the back of the volume control. The flying lead from the power transformer connected to the opposite switch contact so that, in effect, the pot. switch doubled as a tag point to bring the power lead and transformer lead together. But what of the other power lead? It needed a tag point too, but apparently nobody was going to waste money supplying and fitting this as a separate item; not when there was a perfectly good one already fitted, namely, the unused pin 9 on the 6V4 rectifer socket. So this became a mains terminal.

My first reaction was to wonder whether this arrangement was one created by the manufacturer, or whether it was a "bodgie" job on the part of some serviceman. After due consideration, I concluded that it was most likely the manufacturer's idea. One reason was that I could find no evidence that this part of the set had ever been modified. Another was that a colleague recalled having encountered the same arrangement in the same make of set several years earlier.

But regardless of who was responsible, I must state most emphatically that I don't like the idea. Knowing the things that can happen inside valves it doesn't take much imagination to conjure up some pretty grim possibilities. Such as a loose particle of material inside the envelope which happened to lodge between pin 9 and, say, the heater. With no earth on the chassis, which is a perfectly reasonable possibility, the chassis would be connected to one side of the mains.

And if this happened to be the active side . . .

Nor is this the only possibility.



A built-in safety hazard? Using an internally connected valve pin as a tag point for a mains lead would appear to be taking an unnecessary risk for the sake of a small cost saving.

Most valve manufacturers list pin 9 of the 6V4 as "IC" (internally connected), together with the following general instructions:

"It is recommended not to use the tags of spare valve socket contacts as anchoring points in the circuit wiring. This may adversely affect the characteristics of the valves . . . etc."

"When a pin is marked 'internally connected' no connection must be made to the corresponding valve socket tag."

Some valve manufacturers have expanded this thought by pointing out that valve users should allow for the possibility that an unused base pin, even if not used in any way in current production versions of the valve, may form a part of the internal structure of the valve, to the point of actual connection to other elements, in future production runs. And, I might add, in production runs of other manufacturers.

From all this I think is can be fairly assumed that there is at least some risk that this pin could become connected to one or other of the valve elements and via this and external connections to the receiver chassis. As before, in the absence of an earth lead, this could result in a "live" chassis, with all the possible consequences that this implies.

Granted, it may be possible to show that, statistically, the risk is small. But even if it is, is it worth taking when it is so completely unnecessary?

As far as I'm concerned it isn't. Immediately the set in question had been photographed I fitted a conventional tag strip and transferred the leads to it.

I don't want any accidents on my conscience.

Following publication of a letter from a Mr T. G. of Canterbury, N.S.W., in last month's notes, I have received a letter from a South Australian reader commenting on this. A condensed version is reproduced below, without the usual quote marks.

The "Serviceman" article concerning 50Hz general purpose outlets and caravans in the June "Electronics Australia" article raises a few interesting points.

The writer does not make it clear whether the caravan park general purpose outlet was a combination switch plug type (which automatically gives a uniformity of connection provided the incoming active, neutral and earth are correctly connected) or a separate switch and plug socket which allows for varying positions of the active and neutral in the plug socket (even though the incoming active is correctly wired to the switch) depending on the whim of the installing electrician.

The S.A.A. wiring rules do not make it mandatory for G.P.O.s to be polarised but recommend that the sequence when viewed from the front should be earth, active, neutral, in a clockwise direction.

If the offending outlet was a switch plug combination with the switch wired in the neutral conductor then S.A.A. wiring rule 2.19.1 has been violated and a potentially dangerous situation results. If, on the other hand, a separate outlet and switch is used and the position of the active and neutral in the socket varies from that found in a combination switch plug, the rules have not been breached nor is a dangerous situation necessarily created.

The author concluded by saying, "The sooner some pressure is brought to bear on the supply authority to set a firm standard for G.P.O. wiring the sooner these problems are going to be settled once and for all."

In the opinion of this writer a "firm standard" already exists in the "S.A.A. wiring rules" and the "S.A.A. code for electrical installations in caravans and caravan parks" and if correctly applied the latent danger is minimised as much as it ever can be.

If, by "a firm standard," it is meant that "general purpose outlets" should be polarised, nothing is achieved unless the polarisation is followed through the "flexible cords" to the caravans and appliances — a situation which is virtually impossible to effectively police.

The general purpose outlet in the caravan park could be correct in every detail and the same (dangerous) conditions could exist in the caravan, depending on how the electrician or handyman wired the interconnecting flexible cord.

The principle of using a double pole circuit breaker in a caravan is an excellent move but the placing of a neon indicator between active and earth and a 250 volt 15 watt pilot lamp between neutral and earth make it possible for an extremely dangerous situation to develop without any warning from the pilot lamps or malfunction of any of the electrical appliances or lighting.

An open circuit in an earthing conductor can remain undetected until a breakdown of insulation occurs between an active and metallic enclosure or caravan framework, which then become alive because there is no path for the fault current and the fuse is not ruptured.

It is not uncommon to find flexible cords having the active and neutral intact but the earth open. Consider this situation in the flex between a caravan and its general purpose outlet in the park with the pilot light set up mentioned above. The neon pilot will light if the open circuit earthing conductor runs parallel to the neutral as in a 3-core flex thus giving a false picture of the abnormal situation. Similarly, the 15-watt pilot cannot differentiate between a neutral or active and has the serious disadvantage in the latter case of making any framework attached to the earthing conductor alive.

The S.A.A. rule requiring double pole switches in caravans is the simplest, cheapest and most effective method of coping with reversed polarities.

The most important (and the most neglected) regular check that should be carried out is on the earthing circuit. A simple system using a change-over switch, pilot light and a normally open push button (see diagram), built into the caravan wiring would provide a useful test which could be used by most people. This method does not check the impedance value, locate partially broken conductors or detect reversed neutrals and earths, but is still better than no test at all and does not leave the framework alive if the earth is open circuit.

It seems unfair to place the blame squarely on the shoulders of the supply authority when a correctly wired caravan would present no problem irrespective of any so-called neutral and active reversal at the general purpose outlet.

Yours faithfully,
L.N., Broadview, S.A.

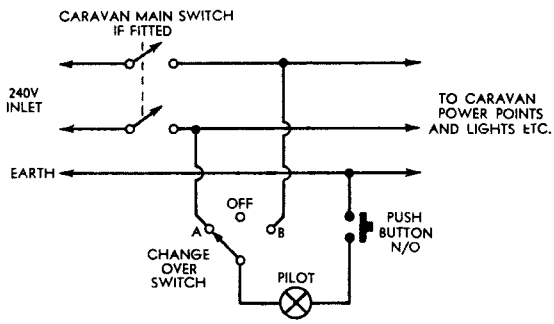
For the most part I would agree with L.N.'s remarks, but both his and Mr T.G.'s letter raise some interesting points. Whereas Mr T.G. felt that more needed to be done by the supply authorities in regard to standardisation of the G.P.O.s, Mr L.N. seems to feel that more needs to be done to standardise the wiring within the vans and to do everything possible to make them safe regardless of the condition of G.P.O.s.

Personally, I feel that both halves of the system need equal supervision, and I intimated as much in last month's notes. By all means let us standardise the G.P.O.s and ensure that they, in themselves, cannot contribute to a dangerous situation. But equally, let us take all possible precautions within the van, even to the point of assuming that G.P.O.s could still be at fault.

I cannot agree that the S.A.A. rules are entirely adequate at the moment. No doubt this body has a good reason for specifying the preferred arrangement of active and neutral pins merely as a "recommendation" rather than a "rule," but I do feel that making it a rule would contribute at least something to overall safety. Even if it encouraged only a small percentage of vans to be wired correctly, rather than otherwise, it would be a step in the right direction.

Another problem, which has not been mentioned so far, was brought to my attention by a colleague who recently returned from a caravan trip. At one park the number of G.P.O.s was hopelessly inadequate and the only way all the vans could be accommodated was by the use of double adaptors. As each new van arrived an existing lead would be withdrawn — plunging that van into temporary darkness — another double adaptor fitted,

(Continued on page 189)



When testing keep clear of metal van or appliances. Close button and set switch to "A" and "B". If earth circuit is intact lamp will light when switched to the active line.

FRAME ANTENNA FOR MEDIUM-WAVE DXING

This article by Charles Molloy appeared in a recent issue of "Practical Wireless." Although intended primarily for European readers, much of the information should be of value to DX enthusiasts in Australia and New Zealand.

Interest has been growing recently in the medium waves. DXers who look for something different, something more exacting or who are simply curious to sample local broadcasting from other parts of the world are turning to the "broadcast band." The medium waves do offer a real challenge. In Europe the main problem is interference: several hundred stations broadcast on unauthorised frequencies or use excessive power. Many are on the air 24 hours a day, so the band is never quiet after dark. Directional antennas help to counteract the problem. Loop antennas, based on the frame antenna that was popular in the early days of radio, are now standard equipment for the majority of MW DXers.

The second problem is knowing the right time to listen. Most parts of the world, with the exception of Australasia, can be logged at some time of the year. The hobby is not seasonal and is not restricted to the winter months. All that is required for success is a path of darkness between transmitter and receiver and, of course, favourable propagation conditions. Broadly speaking the best DX to be had in the U.K. will be trans-equatorial in summer and from the northern hemisphere in winter. The Far East is only heard in winter while stations in East and South Africa are usually only logged in summer.

There is no lack of stations, in fact there are many more of them on the medium waves than on all of the short-wave broadcast bands put together — over 5,000 in the United States alone. Canada, United States, Caribbean, Central and South America, Africa, Near East, India, China and Japan, have all been logged on numerous occasions by DXers in this country.

The medium waves are used almost exclusively for local broadcasting, propagation being by ground wave. During the daytime the sky wave is absent since high angle radiation is absorbed by the lowest part of the ionosphere — the "D" layer. This layer disappears at sunset enabling refraction from higher regions to take place; even vertical radiation is returned. The sky wave interferes with the ground wave to produce severe fading in areas where the two are comparable in strength. As distance increases from a MW transmitter, an area is reached where selective fading and distortion occur after dark limiting the useful night-time range of the transmitter.

The ground wave diminishes in strength as the distance from the transmitter increases and finally disappears. Beyond this point after dark only the sky wave can be received, we are now out of the normal service range of the transmitter and the signal is becoming DX.

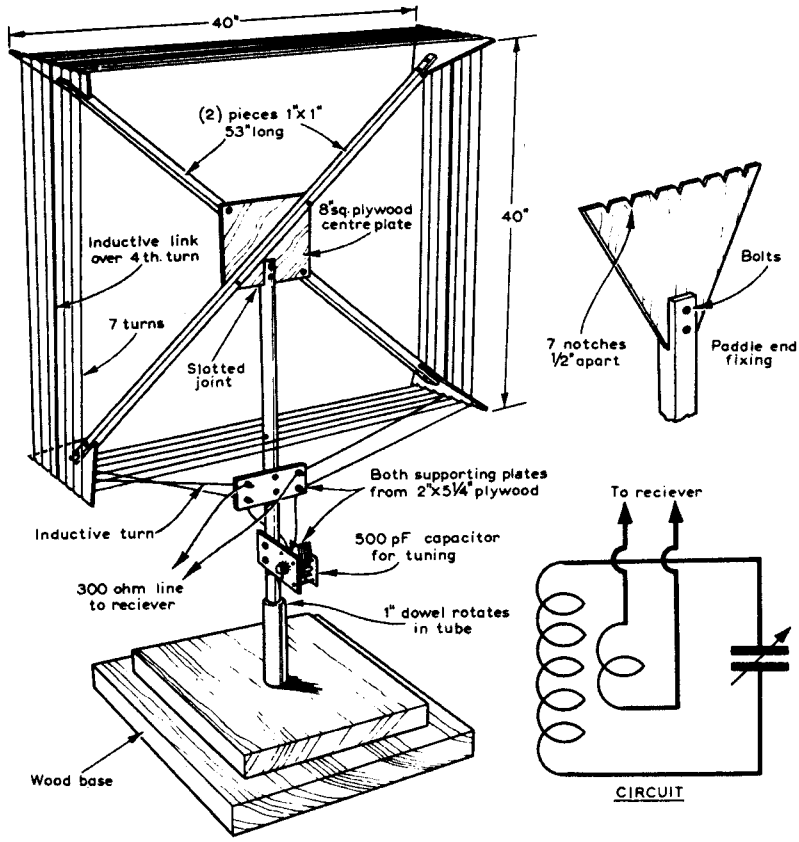


Figure 1. The loop antenna and, lower right, the method of connecting it to the receiver.

Anti-fading antennas are used by large numbers of medium wave transmitters. This type of antenna, which is vertical, puts out maximum signal at low angles to the horizon and minimum signal at high angles. The reduction in high angle radiation reduces the amount of sky wave into the service area, consequently fading decreases and the night-time range is extended.

Low angle radiation is of great interest to the DXer. It enters the ionosphere at a shallow angle and can travel up to 1,500 miles in a single hop after reflection by the "E" layer. Often it continues for thousands of miles in successive hops when propagation is favourable. Conditions on the medium waves are more variable than on the short waves, a factor which frequently causes disappointment to the newcomer. Persistence and patience are the qualities required of the MW DXer. If you do not hear North America at the first attempt then try again a few days later. If conditions are poor they are unlikely to remain so for long.

No serious MW DXer would be without a loop (figure 1). This type of antenna is directional; maximum pick-up is along the plane of the windings, minimum pick-up along a line at right angles to the windings. The depth of the null (degree of signal suppression) depends on the electrical balance of the windings so it is important that they should be symmetrical.

The loop is very simple to use. Tune

in a station on the receiver, peak it with the loop tuning control and rotate the loop for optimum reception. Frequently it is possible to null-out different stations on the same frequency, e.g. on 1070KHz CBA in Canada can sometimes be heard free of interference if the null is pointing towards LR1 in Buenos Aires and similarly LR1 can be heard with CBA nulled-out.

There are additional benefits to be had from a loop. Static is reduced in early summer when much of it comes from thunderstorms to the south; it can be eliminated when listening to the west. Overloading and cross-modulation are reduced, leading to the unlikely, but quite correct, claim that audio quality is sometimes better when using a loop. Direction finding can be a help to station identification. Turn the loop until the unidentified station disappears, when its direction will be along a line at right angles to the windings.

The 40in loop is a compromise between pick-up and convenience. A larger loop will have greater pick-up. Alternative sizes can be constructed, using approx. 100ft of plastic covered wire of about 22SWG for the main winding which should be wound to a whole number of turns. If the loop will not tune to the HF end of the band there are too many turns. If it will not tune to the LF end then add turns or increase the value of the tuning capacitor.

If anyone has space to erect a long wire antenna several wavelengths long he will find it is directional along the length of the wire and the pick-up will be far greater than that of a loop. DXers in New Zealand achieve remarkable results using long wires. Few of us in this country will have the space for this type of antenna and it is doubtful if one would be of value in the presence of strong QRM.

No one should be deterred from DXing on the medium waves through lack of an outside antenna. The ordinary TV antenna gives excellent results when used in conjunction with a good earth at the receiver. Connect the inner wire of the co-ax downlead to the antenna socket and earth the outer braiding. In some locations better results will be obtained by using the co-ax outer as the antenna.

EDITORIAL NOTE: The remainder of the article is largely concerned with European reception conditions and specific stations which can be heard by European DXers; it is unlikely to be of great interest to listeners in this part of the world. However, a number of intertesting points are raised which should be of value to all MW DXers.

An expensive communications receiver is not essential to receive DX stations on the medium waves, especially if a loop antenna is used. Desirable features, however, are good sensitivity and selectivity, and freedom from cross-modulation and overloading. The loop antenna described here is obviously best suited to receivers with a conventional aerial coil, and conventional aerial and earth terminals, to which the coupling loop can be connected. Where the receiver has a built-in loop or ferrite rod antenna, the directivity patterns of the inbuilt and external antennas could become confused.

(Continued on page 190)

A READER BUILT IT

Capacitor Measurement with Solid State VOM

A reader describes a number of modifications to the Solid State Volt-Ohm Meter of December, 1968, including circuitry to provide direct reading of capacitance. This facility can even be extended to electrolytic types.

Recently having the need to measure several paper capacitors (value unknown) I devised the enclosed circuit to be used in conjunction with my modified version of the "Electronics Australia" SSVM. The scale law it follows is the same as the existing ohms scale, and the capacitance range selector is identified with the centre scale value of the range selected.

The procedure to use it is the same as for any ohm meter. First, short the leads together and adjust the "infinity set" control for FSD with the meter selected to 10VAC. Then select a suitable capacitance range and connect the capacitor to be tested. In practice this works very well and makes a useful accessory to the "EA" meter.

As shown by the attached circuit, I have altered the meter AC voltage rectifier circuit to give a greater margin of safety on the higher AC ranges and included a 1VAC range in the meter itself by using a separate germanium diode for the low AC ranges and a separate 1VAC scale.

To overcome an appreciable calibration drift with battery voltage drop (approximately 1 per cent per volt change), a zener controlled regulator was incorporated. This not only cured the calibration drift but, by running the circuit at 15 volts, the standing current is reduced by an amount which more than compensates for the slight zener diode bleed current, thus giving a marginal increase in battery life.

One fringe benefit of the battery switching circuit is that in the "OFF" position, operating the Battery Test switch gives battery volts, while in the "ON" position the zener regulated voltage is monitored. This enables both battery condition and zener action to be verified.

Finally, current ranges were added as a logical extra and resulted in a 1 per cent accuracy meter with comprehensive volts, amps, and ohms ranges.

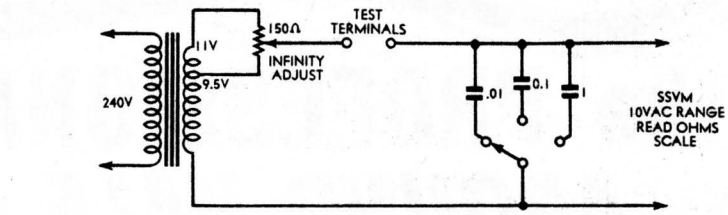
It is also possible, with little additional cost, to test electrolytic capacitors. The only modification required is the addition of two diodes and resistors as shown in the basic circuit.

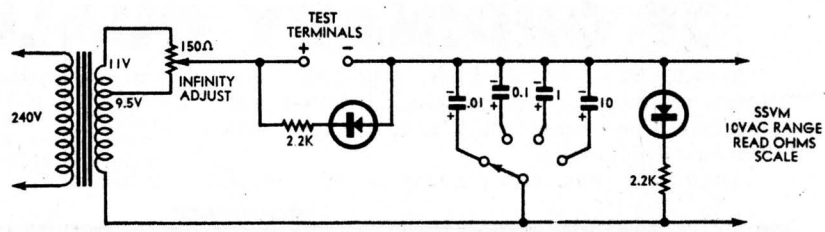
In operation the test and reference capacitors form a voltage divider, the one with the highest voltage developed across it will cause its respective diode to conduct and charge BOTH condensers to the peak value, after which both diodes are reverse biased and play no further part in the divider ratio action of the two capacitors.

The DC bias developed is at least equal to the peak AC applied and prevents reverse current flow through the electrolytic capacitor. The 2.2K resistors act as current limiters in short circuit conditions.

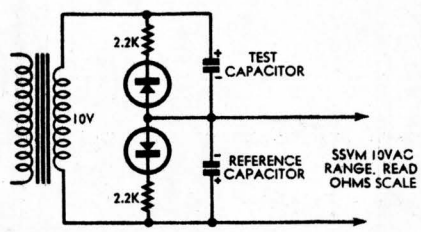
It is possible to use electrolytic capacitors in the reference position also provided the correct polarity is observed. In practice 10uF seems to be the upper limit for reasonable scale accuracy. As the bias voltage developed varies from 7.07 to 14.14 volts DC depending on the ratio of the two capacitors it is unsuitable for very low voltage rating units. A complete practical circuit is shown.

Submitted by: Mr N. R. Ross, 17 Loogana Avenue, Glenroy, Victoria, 3046.





The upper circuit is for a capacitor tester suitable for all non-electrolytic capacitor types. The lower circuit shows the modifications needed to accommodate electrolytic types.



A basic circuit of electrolytic capacitor tester, from which the practical circuit was derived.

★ ★ ★

A complete circuit of the modified VOM, showing other changes and additions, appears on page 105.

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1800′	10D7	1.0 ACETATE	7.25	3.25
1800′	10D7M	1.0 MYLAR	9.15	3.99
2400′	5D7M	.5 MYLAR	10.40	4.75
2400′	5D7MT	.5 TENSIL MYLAR	11.90	5.25
3600′	5D7MS	.33 MYLAR	13.20	6.75
		5½" REELS		
1200′	10D57	1.0 ACETATE	5.50	2.55
1200′	10D57M	1.0 MYLAR	6.00	2.95
1800′	5D57M	.5 MYLAR	8.90	3.75
		5" REELS		
600′	15D5	1.5 ACETATE	3.40	1.80
900′	10D5	1.0 ACETATE	4.15	1.98
900′	10D5M	1.0 MYLAR	5.32	2.25
1200′	5D5M	.5 MYLAR	6.95	2.50
1200′	5D5MT	.5 TENSIL MYLAR	8.70	2.75
1800′	5D5MS	.33 MYLAR	9.60	3.75

LENGTH	TYPE No.	DESCRIPTION & MIL. THICKNESS	NORMAL PRICE	OUR PRICE
		CORRESPONDENCE TAPES		
		3¾" REELS		
900′	3D32MS	.33 MYLAR	3.90	1.95
		3" REELS		
150′	15D3	1.5 ACETATE	.95	.50
225′	10D3	1.0 ACETATE	1.20	.65
225′	10D3M	1.0 MYLAR	1.65	.70
300′	5D3M	.5 MYLAR	1.95	.85
600′	3D3MS	.33 MYLAR	3.30	1.60
		CASSETTES C30	3.10	1.10
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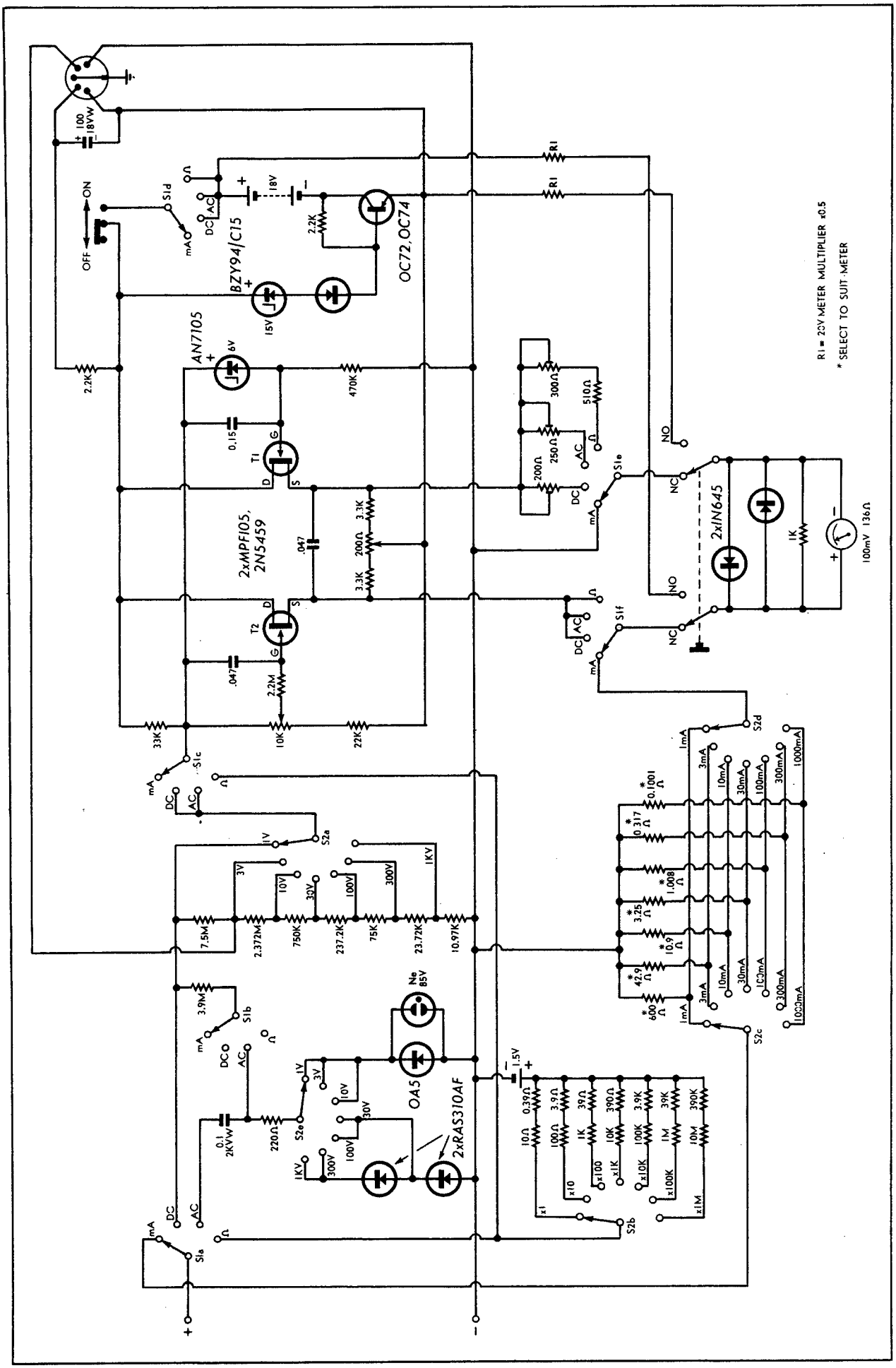
R1 = 20V METER MULTIPLIER x0.5
* SELECT TO SUIT METER
ON
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S1d
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S2c
S1b
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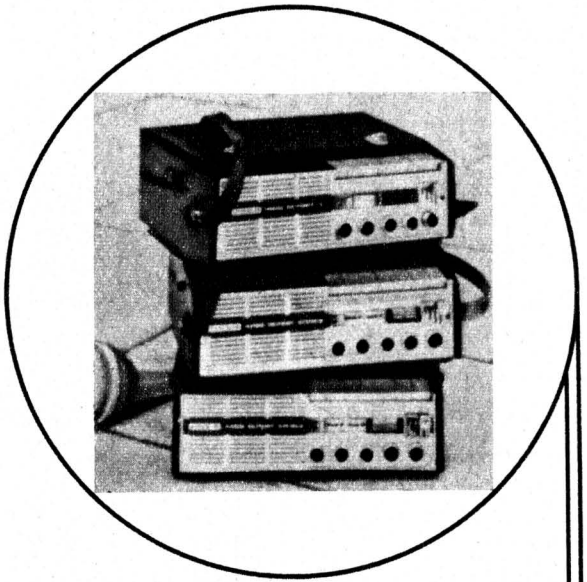

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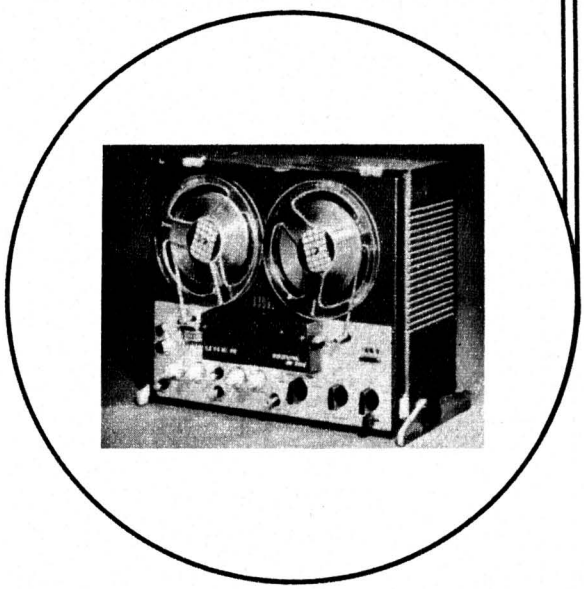

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		VIC.:	Klapp Electronics Pty. Ltd. 224 Chapel St., Prahran. Tel.: 51-4653.		

A READER BUILT IT . . . continued

Horizontal Deflection Tester

If you are interested in novel devices to assist servicing activities, this simple EHT checker should appeal. It probably could be made from junk box parts for virtually nothing.

Inspired by some of the recent comments in the Serviceman notes, here is a description of a simple horizontal deflection tester which, by reason of its simplicity, small size, and ease of use may be more suitable for field work than the more elaborate methods sometimes suggested. I first saw the idea in "Radio Electronics" for October, 1965, as commercial device. I made one for use by a relative who is a professional serviceman. It has been in use for several months.

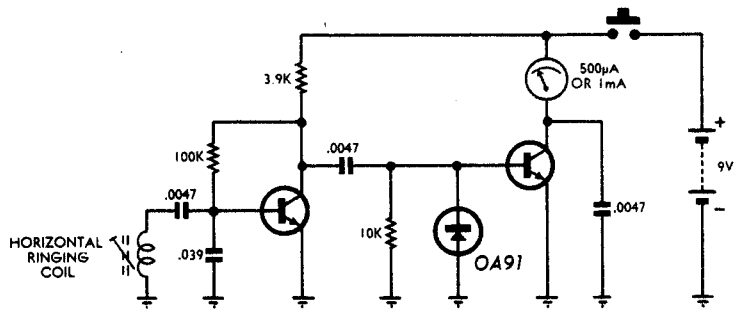
The device consists of a pickup coil, a signal amplifier, a detector, a DC amplifier and a meter. It is powered by a small 9V radio battery.

The pickup coil is an old horizontal oscillator coil and this should be mounted near the outer edge of a non-metallic box. (Editorial Note: Although not mentioned by the author, it seems certain that he intended the pickup coil to be resonated at 15625Hz by the selection of the capacitors across it and the adjustment of its internal slug.)

The transistors are oddments from a computer board. Any general purpose transistors would seem to be suitable.

In use, the tester is held about six inches away from the EHT lead. On pressing the "ON" button the meter should read nearly full scale, depending on the exact distance from the lead. If no reading is obtained move the tester close to the horizontal amplifier stage. If there is still no reading, move it close to the horizontal oscillator or its ringing coil. By this means it is possible to check whether the horizontal oscillator, amplifier, and EHT circuits are working, without making any connection to the set.

Submitted by: Mr A. D. Fuller, 406 Pennant Hills Road, Pennant Hills, N.S.W. 2120.



The circuit uses only a few non-critical components, most of which are likely to be found in the junk box.

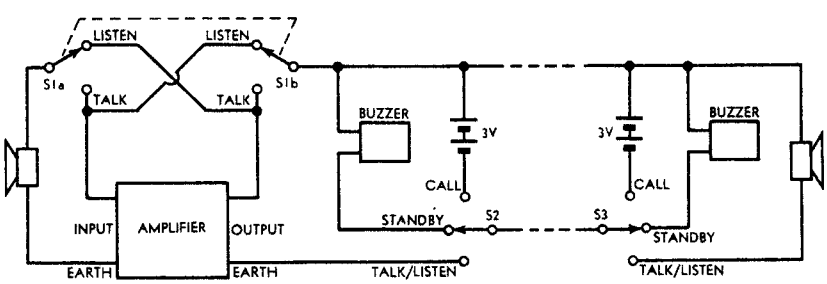
Simple Intercom

Most experimenters have a need for an intercom system at one time or another, such as between the house and the workshop. The simple set-up described here would be all that was needed in many cases.

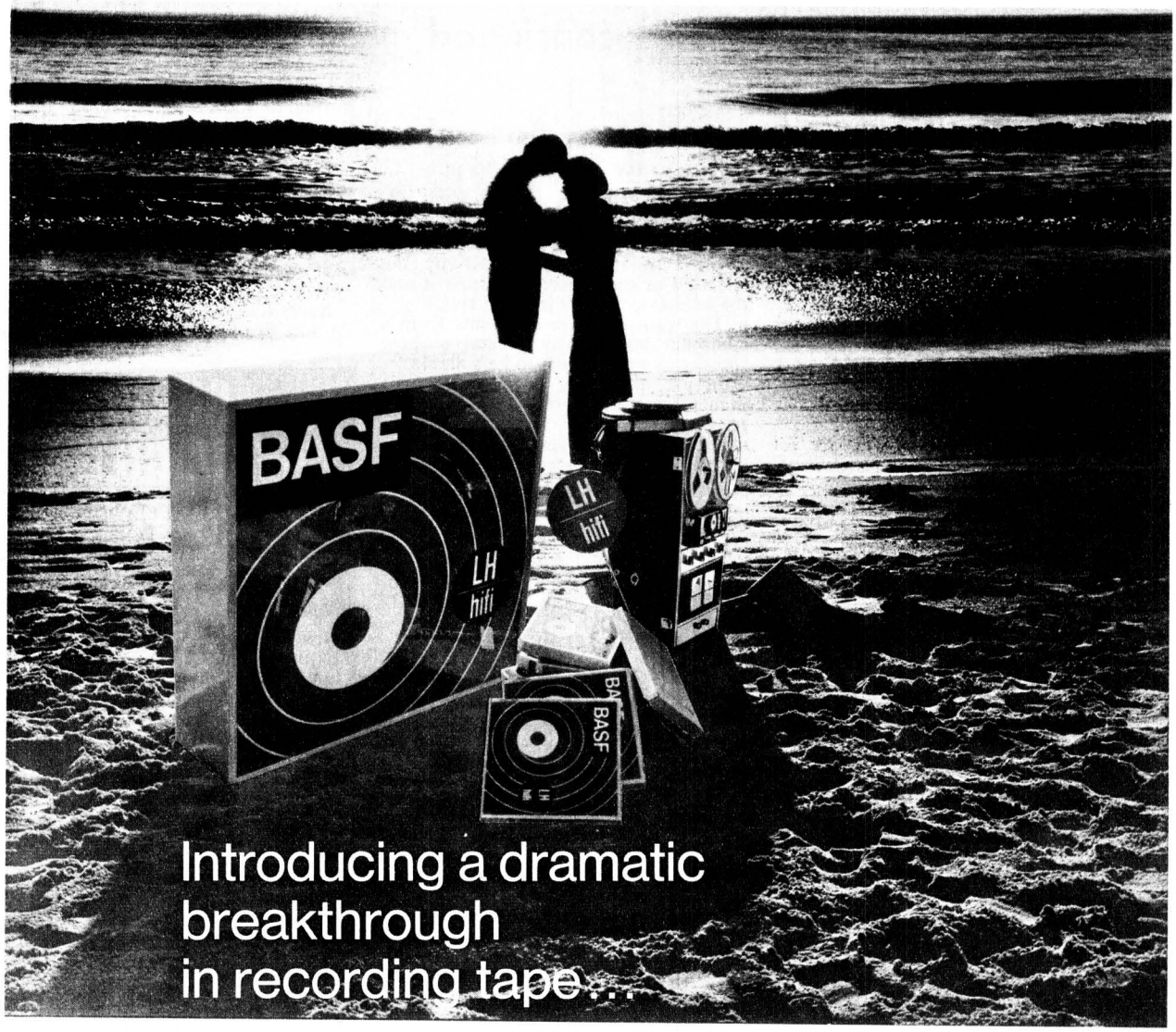
Here is a circuit of a simple intercom set-up. A small loudspeaker at each end of the system acts as both speaker and microphone, depending on the direction in which the amplifier is working. Both ends of the system require a function switch to allow the other station to be called and a buzzer to allow the station itself to be called. The switch is a three-position, single-pole type, preferably with a spring-loaded action in the "Ring" position. It is normally left in the "Standby" position until the buzzer sounds, then moved to the "Speak/Listen" position. When initiating a call the switch is first moved to the "Ring" position, then to the "Speak/Listen" position.

A "Press-to-Talk" switch is provided at the master station only. This is shown as a two-pole, two-position switch. One advantage of the circuit is that it requires only two wires between stations, and another that both stations have complete privacy while ever their switch is in the "Standby" position.

Submitted by: Mr D. Kaye, 18 Peake Parade, Peakhurst, N.S.W. 2210.



Simplicity is the main feature of this intercom, which nevertheless offers most of the features needed in any two-station system.



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AUDIO TOPICS

Loudspeaker-cum-pipe units for Conn organs

An interesting accessory to Conn electronic organs is a loudspeaker system which resembles a rank of pipes. Is it a pure gimmick or does it have qualities which could contribute to the character of the final sound?

When we put the question to a representative of Conn in Sydney, Messrs R. H. Elvy Pty. Ltd., their answer was very simple: Run some tests on a unit for yourselves!

A number of different units are available in the Conn range, with larger and smaller "ranks" and with the pipes arranged in different configurations to suit the fancy of individual purchasers.

The unit pictured involves a solidly constructed base, measuring 42 x 6 x 8 inches. It supports 48 pipes in all, ranging in length from about 27 inches to 1 inch and in diameter from about 1½ inches to 3/8 inch. The pipes are metal, finished in dull gold and, in fact, the appearance and workmanship is excellent.

The literature that comes with the loudspeaker-pipe unit says more or less what one would expect it to say. It stresses that the pipes are very carefully tuned to individual notes of the musical scale. It carries the clear implication that a unit which looks like a pipe rank, and which is tuned like a pipe rank, must be able to contribute pipe-like qualities to an electronic organ.

In case we were doubtful about the claims in the brochure, there was apparently no lack of commendation from organists who had tried the unit and been impressed enough by it to sign a cheque on the spot. What basis could there be for such a reaction?

As the accompanying photographs indicate, the base of the unit is a solidly built, elongated, sealed enclosure, with four 9 x 6 inch loudspeakers end to end, facing upward. It is padded internally and is virtually a line-source loudspeaker system, positioned horizontally instead of vertically. The loudspeakers are connected in phase, in series parallel, to present a nominal impedance of 8 ohms.

When fed with signal, the four cones move in unison and radiate upward through an array of pipes.

Here there is a most obvious difference between this unit and a wind-driven rank, where the only pipes which can propagate sound are those which are selectively blown at any particular instant. In the Conn unit, with all loudspeakers radiating simultaneously through all pipes, one might readily jump to the conclusion that the array of pipes is nothing more than an elaborate fret; that the advantage of the system, if any, would come from the natural dispersion of sound being projected toward the ceiling rather than directly toward the audience.

However, examination of the behaviour with a microphone and a variable frequency tone source indicated that there is more to the operation than this.

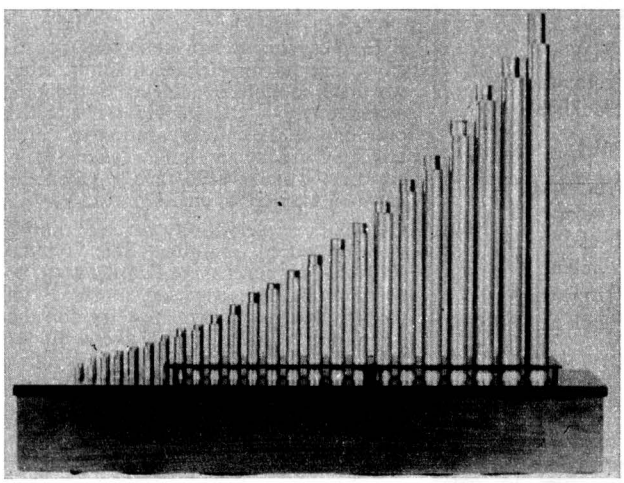
To be sure, all loudspeakers do radiate directly through all the pipes and, to this extent, any remark about the pipes constituting an elaborate fret is justified.

At the same time, close-up listening with the microphone indicates that individual pipes, or groups of pipes, do tend to resonate and to augment the acoustic output by 6dB or more when the tone being fed through the system approaches their air-column resonance. It is possible to follow the effect progressively from the larger to the smaller pipes as the test tone is raised in frequency.

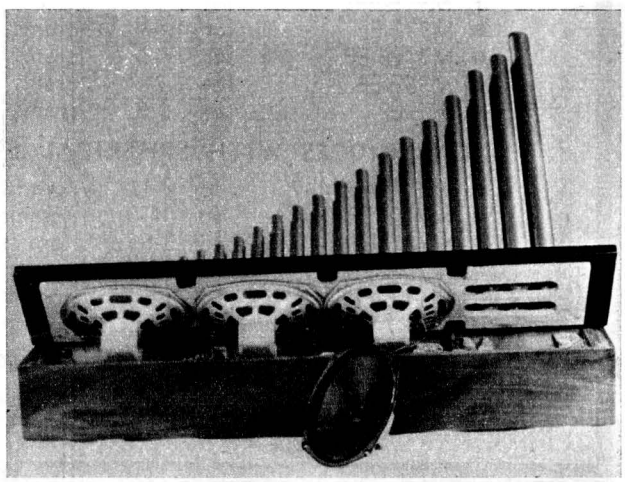
To the listener, standing back from the unit, there is a tendency to identify the total sound with its most prominent source, which is the resonant pipe for that particular frequency.

In the case of the unit pictured, the nominal frequency range accommodated by the pipes is from 120Hz to 1900Hz. Other units extend the coverage downwards.

When a complex tone is fed through the system, the tendency is for the fun-



The Conn model 145 "Electronic Pipe" unit, which is the subject of comment in this article. Other units cover a lower frequency range and/or offer a different configuration of pipes.

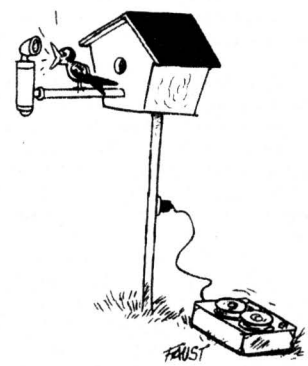


An inside view of the Electronic Pipe unit, with one of the loudspeakers detached. Radiation at frequencies above the range of the pipes is limited by the obstructions in front of the cones.

damental to be radiated most strongly from one pipe (or group of pipes) and the individual harmonics from other pipes (or group of pipes). There is therefore an inherent frequency-conscious dispersion effect which can be expected to broaden the apparent source of sound, as compared with a more conventional loudspeaker system.

One would logically expect the effect to be most apparent from the larger pipes because of their superior coupling to the loudspeaker cone. And looking at the system as a complicated fret, one would expect the higher frequencies to suffer from limited egress, giving something of a top-cut effect to the overall reproduction.

To test these theories, we coupled this system and another conventional bookshelf system to the respective channels of a stereo amplifier which had separate tone controls for each channel. It was immediately apparent that the Conn loudspeaker-pipe system did have limited high-frequency response, roughly equivalent to having the treble control on a normal amplifier channel turned to about two-thirds cut. In itself, this would tend to attenuate high order harmonics and modify organ voices towards a "flute" characteristic.



("Deutsche Welle Programm.")

But the interesting thing was not the limited top response, which could readily be achieved by other means, but a most noticeable dispersion of the sound source.

In fact, the system achieves acoustically, and in an elegant manner, what we once sought to achieve in the pre-stereo days — the left-right dispersion of mono sounds by separating the high and low frequency loudspeakers. It is an effect which would readily catch the ear of a pipe-conscious organist.

But the observations set our minds working along another line. If the problem of purchasing, duplicating or accommodating one or more Conn units is too great, why not try for the same effect using loudspeakers alone? Why not a whole array of smallish loudspeakers, suitably dispersed and fed through simple series-resonant filters, to provide a sequence of overlapping response curves?

They might easily produce a very pleasing dispersion effect. It is something we want to look at — if and when we get time! If any reader likes to develop the idea, we'd very much like to hear how they get on. ■

KEEP COUNT OF SIDES PLAYED

Some manufacturers suggest that the pick-up stylus be examined under a microscope at least once every thousand LP sides. Some suggest other figures. But how does one keep track of the number of sides played? This counter, placed alongside the turntable, will help you remember; it is simply flicked each time a record is played.

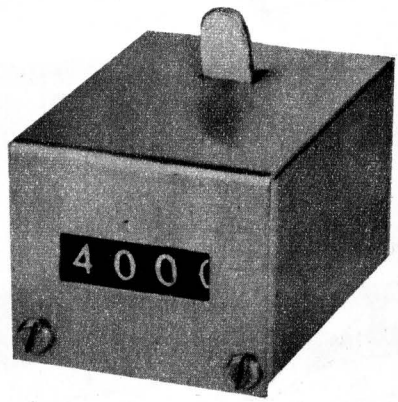
By Ross Tester

Basically, the counter is contrived from an electro-magnetic counter, designed to run from 50-volt pulses. If required, it could be left as such, but having to arrange electrical impulsing would render it too complicated for the task we had in mind. As it is, the only outlay required for the unit is the cost of the counter, plus a small amount of aluminium for the case.

It has been suggested that such a unit would be more useful if it were somehow connected to the pick-up arm itself and automatically triggered. While this is possible, we feel that it is hardly warranted. The counter requires very little effort on the part of the operator to trigger.

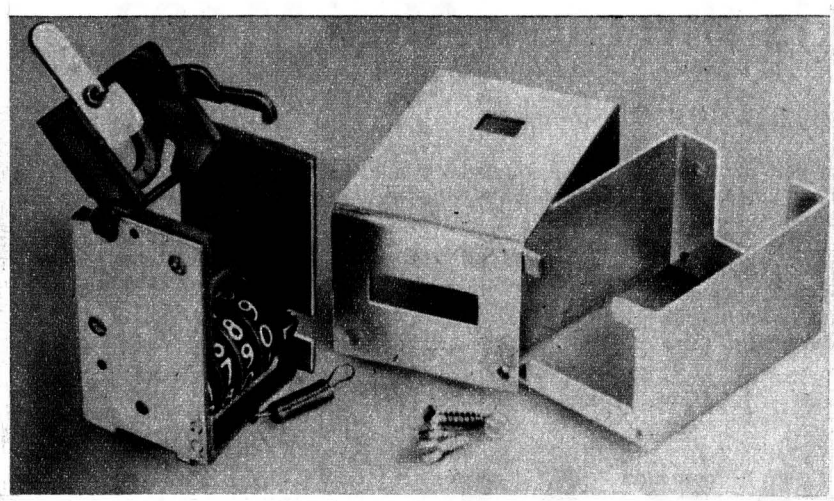
The counter we used was one of those available from disposal stores for a dollar or so. Ours came from Deitch Bros., of Sydney and cost $1.25. It is a relatively simple matter to convert the counter to mechanical, rather than electrical operation. All that we found necessary was to fit a lever to the armature of the relay, thus replacing the pull of the magnet with a push from the fingers.

Not requiring the magnet, we cut it and its frame off the counter section with a hacksaw. If preferred, the magnet can be removed intact by disassembling the unit and lifting it out. The frame, however, must still be cut away, though care must be taken to leave adequate metal to support the required mechanism. Approximately 2½ inches should be cut away.



All that is required to operate this simple counter is to push the actuating lever, which has been added to the original unit. The counter may be left in any convenient position near the turntable.

The case which the unit comes in is unsuitable for our present purpose since it covers only the readout movement. We elected to construct a new case which would look the part and be more robust. Messrs Radio Despatch in Sydney were able to supply a "minibox" (type No. AMB-2) which neatly accommodated the unit crossways. It was much too long but it proved a fairly simple matter to bend the minibox



The counter completely disassembled. The lever which is added to the mechanism can clearly be seen on the armature of the old relay, at the extreme left of the picture. The hook which can also be seen on the armature normally engages the ratchet wheel of the counter. It is this hook which actually progresses the numbers.

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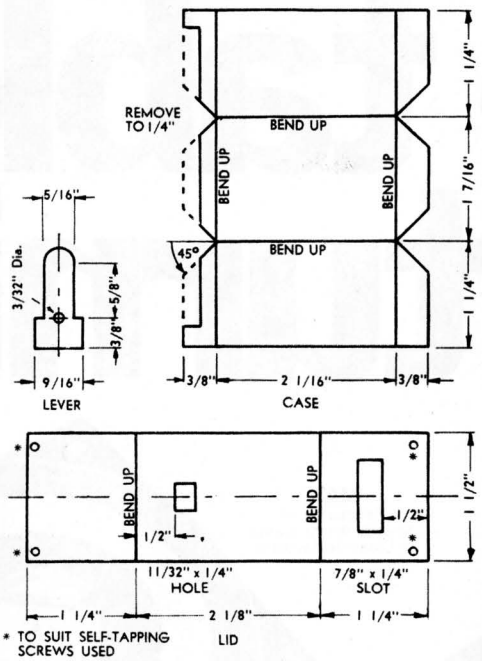
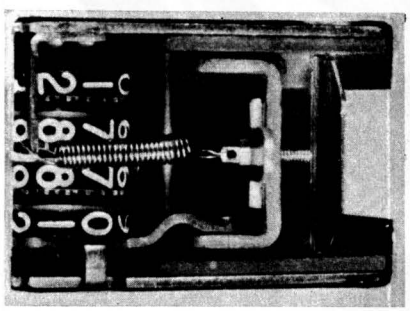
into the required size, and remove the excess material. As there is not much material to remove, a nibbling tool is the ideal way to do it. Dimensions are given, however, for those who wish to start with aluminium scrap and build their own case. Either 16 or 18 gauge aluminium is quite suitable both for the case and the operating lever, for which dimensions are also given.

The position of the lever can be seen from the photographs. It is attached with the screw which originally performed the setting function, and which also holds the return spring.

At right are the dimensions of the case we contrived to house the counter. The dimensions may have to be modified slightly if the counter you obtain is not a duplicate of the prototype. This unit is shown below. Note that the setting screw for the original relay armature now holds the operating tab and the return spring.





Holes for the self-tapping screws should be drilled after assembly, to ensure a tight fit, and to anchor the movement properly. The screws in the front of the case actually go into the movement itself. It is important that the screws in the rear only attach the lid on the case, and do not touch or penetrate the movement. Failure to note this will almost certainly result in the movement being pushed out of alignment, and in failure to operate. In fact, it will probably be necessary to remove a small amount of the movement with a hacksaw or file where the rear screws penetrate, in order to prevent even short screws from pushing on the movement.

If required, a small piece of clear plastic or perspex may be inserted between the case and the lid to form a more attractive window and enhance the overall appearance.

While the counter has no "reset" facility, the number can be reset by removing the shaft containing the travel gears from underneath the counter barrels, and manually resetting the wheels back to zero. The shaft must be replaced exactly in the centre, otherwise one end will dislodge, preventing the counter from working.

However, the simplest way to operate the counter is to work it round until a suitable "round figure" comes up. You can then resolve to check the stylus on each new 100, even numbers of hundreds, every 500, or every 1,000.

The frequency with which a stylus should be checked or replaced varies widely with circumstances: The nature of stylus (whether diamond or sapphire) its shape and dimensions, playing weight, stylus system compliance, the condition of the records and how much the user cares about quality, record wear and record damage. The appropriate course is for the user to make a decision for his own equipment, based on maker's recommendations, and to use this counter as a means of giving effect to that decision. ■

NOTES AND ERRATA

HIGH PERFORMANCE AMPLIFIER. (Reader Built It, May, 1970.) In the notes on page 105, par (e), mention is made of 0.1uF decoupling capacitors required to fully bypass the two supply rails. These capacitors have not been shown on the circuit diagram on page 105, and should be connected as close as possible, and with as short leads as possible from pins 7 and 4 of the IC to power supply common (earth).

SOLID STATE VOLTAGE REGULATOR (Reader Built It. June, 1970, p101). Zener diode shown as BCZ63. This type number, shown in this article and the original in the May, 1967 issue, should have read BZY63. The BZY63 is now an obsolete type and a more up to date version of the same rating is the BZY88-C9V1. If neither of these diodes is obtainable, any 9V 400mW type will be suitable.

"ECONOMICAL AUDIO OSCILLATOR" (June, 1970, page 77). Parts list should read: 1 1M linear dual ganged potentiometer, not 2M.

EXPERIMENTAL FM DISCRIMINATOR (June, 1970). Type numbers for integrated circuits, in both text and circuit, should carry the prefix uL, not uA. The output terminal of both uL900s, in both circuit and text, should be shown as pin 5, not pin 6. ■

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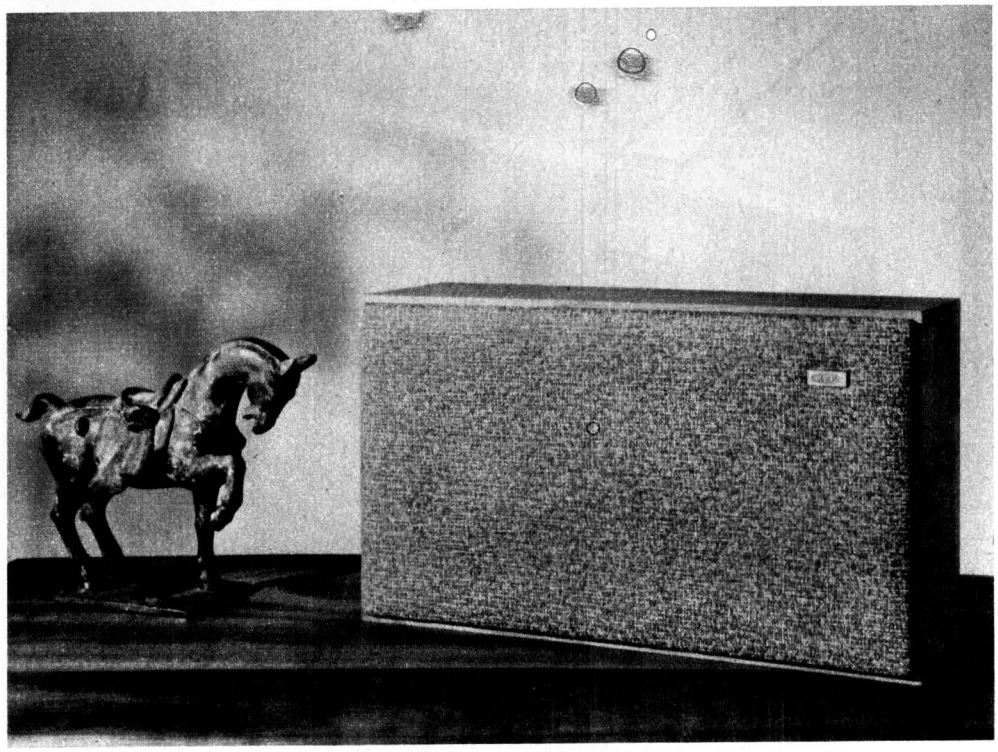

THE KEF "CRESTA"

Here are some excerpts of the review of this remarkable speaker in the October 1969 issue of Hi-Fi News (U.K.):

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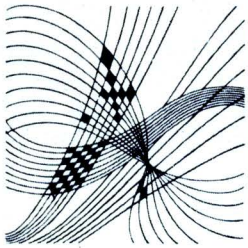

CLASSICAL RECORDINGS

Reviewed by Julian Russell

WAGNER — Tannhauser (Dresden Version). Birgit Nilsson; Theo Adam; Wolfgang Windgassen; Dietrich Fischer-Dieskau and others with the Chorus and Orchestra of the Berlin Opera conducted by Otto Gerdes. DGG Stereo 139284/87.

There is nothing on the box, the labels or even the accompanying brochure to identify this set as either the original Dresden version or the later Paris revision to which Wagner added the wonderful new bacchanale music in the first act and rewrote much of the first scene between Tannhauser and Venus. I was hoping it was the latter but it turned out to be the former. I readily admit that the brief interlude of the Paris Bacchanale with its incandesent orchestration and other evidence of the maturity of Wagner's Tristan period make what follows seem a little homespun. But I personally am prepared to excuse the anachronism for the sheer excitement of the revision which dispenses with the last restatement of the Pilgrims' Chorus. The curtain rises at the climax of the second statement of the old Venusberg music — two high thirds on the trumpets usher it in — and the new music continues uninterrupted for something like 20 minutes.

The reason for its introduction may not be generally known. When Tannhauser was first performed in Paris it was the fashion there for every opera to include a ballet. The directors of the Paris opera insisted on this and suggested that Wagner write a ballet to be performed during the Hall of Song scene in the second act. This Wagner quite reasonably refused to do as it would be completely anomalous there. If they wanted a ballet, he told them, the only place they could have it was in the Venusberg at the beginning of Act I. And that is where it is to be found today — in the Paris version.

But I hasten to add that this omission was the only major disappointment I found in the new set. The cast is formidable with Birgit Nilsson doubling the roles of Venus and Elizabeth. She sings both parts immaculately but, of necessity, her voice has not the luscious low register quality of a good mezzo in the Venus role. In Bayreuth in 1962 I heard Grace Bumbry as a black Venus in the part and very thrilling she was. The Elizabeth, believe it or not, was Victoria de los Angeles and surprisingly good in a role for which I would have expected her to be quite unsuited.

The Tannhauser (Walter Windgassen) seems slightly scant of breath in the first scene but improves steadily until he gives as fine an account of Tannhauser's third act narration — the pilgrimage to Rome — as I have ever heard. It is in this narration, together with the prelude to Act 3, that the later, more mature Wagner, can first be glimpsed.

Fischer-Dieskau is in splendid form throughout. Wolfram is a noble role and it is further ennobled by Fischer-Dieskau's incomparable performance. Theo Adam (The Landgrave) has a few wobbly notes in the low register but is otherwise acceptable. The Shepherd Boy (Caterina Alda) momentarily wanders off pitch but her voice has a beguiling innocence. By the way, to add to what I have already written about Nilsson, I felt that in Elizabeth's Prayer she could have sounded a trifle more spiritual, but this apart there is no denying the admirable quality of her singing.

The ensembles are well balanced and firmly held together, the famous march in the Hall of Song really rousing. And such matters as the horn calls on the Landgrave's entrance and in the Finale of Scene 2 of Act 1 are in excellent perspective. I think this is the best set of Tannhauser available today. But I still regret that it is not the Paris version. There is plenty of unplayed space on the discs to have included it.

★ ★ ★

RAVEL — Complete Piano Works played by Monique Haas. World Record Club Stereo S/4960/1/2.

When I first set about listening to this set I chose what might be called the test pieces to play first. I started with Scarbo because its technical demands are enormous. It is — or rather was until Messiaen and others came along — the most difficult piece for pianoforte ever written. Ravel composed it with that intention. Haas' technique stands up well to its demands. This is a little surprising when one recalls her frail appearance during her tour of Australia some years ago. Moreover Miss Haas imbues it with just the right spirit of mischief, evoking a hobgoblin teasing a restless insomniac. All it lacks is a tiny bit of the weight a male pianist of more than usual ability might give to the climax. Next I tried Jeu d'Eau for fluidity and was not quite so satisfied. Some of the phrases sounded a little square cut. On the other hand the Sonatine is beautifully flexible and inflected with sensitive rubatos of careful attention to changing sonorities.

In an occasional item — the Menuet Antique is one — I thought the playing ever so slightly heavy handed. Since the recital occupies three whole discs there is not the space available here to mention every piece. But I can, on the whole, recommend the set not only on the grounds of its modest club price but on the general high standard of performance throughout.

★ ★ ★

SIBELIUS — Symphony No. 1 in E Minor. Pelleas and Melisande excerpts. Halle Orchestra conducted by Sir John Barbirolli. World Record Club Stereo S/2803.

After the exquisitely played opening clarinet solo I was a little surprised that Barbirolli, of all conductors, did not plunge head first into Sibelius' romantic sea. For the Sibelius First is a very romantic symphony indeed. Barbirolli, to me, seems overly cautious, during the first few minutes or so, testing the temperature of the water with his toes first, so to speak. However once he embarks on the brass interjections he gives them all the snap and bite one expects to be awarded to one of the greatest writers ever for this department of the orchestra. If the Halle strings haven't quite all the bloom of those of other fine orchestras they play with commendable attack and smooth phrasing.

Barbirolli surrenders himself completely to the mood of the slow movement, starting it as sensitively as might be imagined in preparation for a climax of truly awesome porportions, later sinking back into what might almost be hopelessness and resignation. The tempo of the scherzo is rather more deliberate than I would have expected, but once you get used to it, it gives you plenty of time to savour the colour. In the Finale the lack of bloom on the strings is still more noticeable than in the first movement. But that is all that detracts from an otherwise most impressive reading. The Melisande fills are very well played indeed.

★ ★ ★

DVORAK — Symphony No. 8 in G Major. (Old style numbering No. 4.) Vienna Philharmonic Orchestra conducted by Herbert von Karajan. World Record Club Stereo S/4689.

When, in 1965, I heard the London Symphony under Kertesz play this symphony in the Vienna Konzerthaus I thought it was the best performance of it I had ever heard. So, I think, did the audience, who gave it a standing ovation. Before playing the Karajan I refreshed my memory of the Vienna performance by playing the Decca recording of the same orchestra and conductor I had heard in Vienna. This is still my favourite performance though I admit at once that Karajan and the Vienna Philharmonic run it very close. And if price is a consideration to prospective buyers this World Record Club disc is well worth thinking about. It is, all round, a very fine performance indeed. My reason for preferring the Kertesz reading is that he goes all out for freshness and vitality, ignoring some of Karajan's refinements — of which some listeners may well be overwhelmingly in favour. This is not

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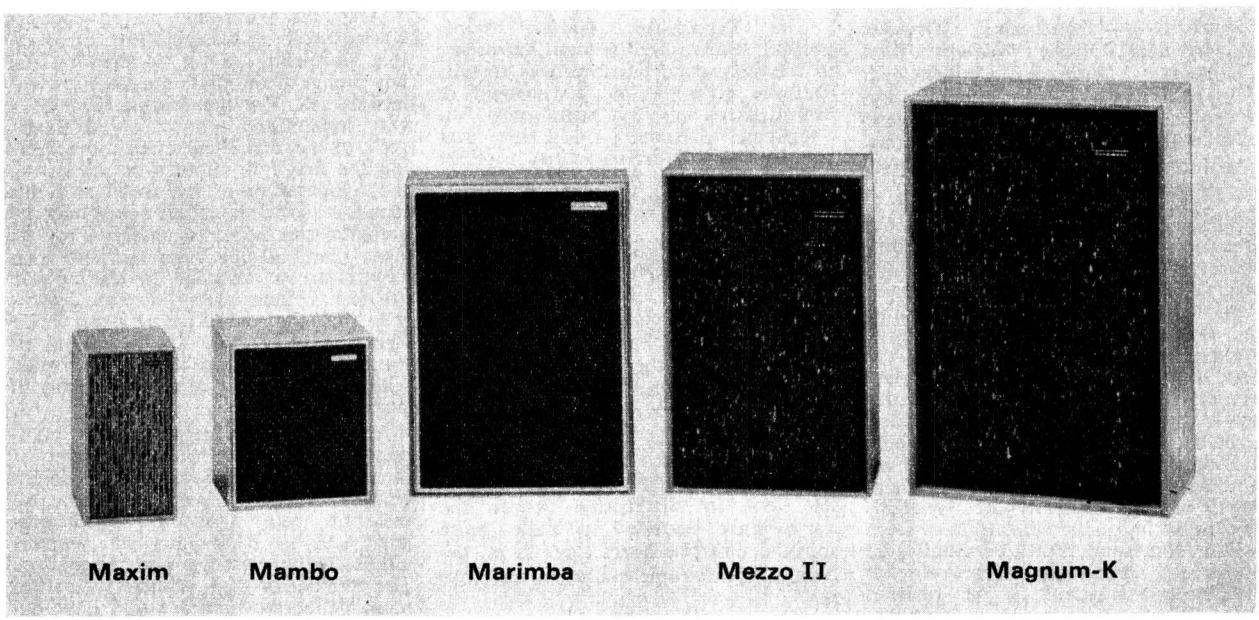

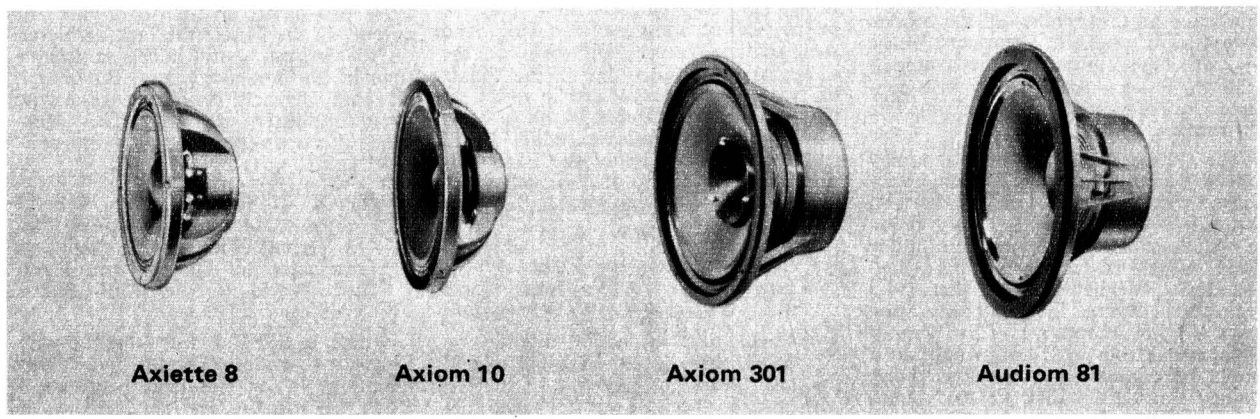

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so noticeable in the first movement in which both orchestras are brilliant and exciting. I admit, without hesitation, that in the second movement, fine though the English strings are, they have not the lustre of their Austrian colleagues. But despite this Karajan tends to refine the movement so that, lovely as it sounds, it loses something of what I can only describe as its peasant quality. Make no mistake, Karajan doesn't scale down the climaxes and the pianissimos are equally impressive, especially the one that precedes the "overblown" horn phrase. But it is all the tiniest bit precious. Again I urge you not to be put off by me. You may well like it played that way. The third movement is all Karajan's with schmaltzy Viennese strings and their incomparable way of dealing with anything in 3/4 time. The Finale is anyone's. The brass playing in both orchestras is magnificent. But Karajan loses impetus in the quiet passages where, despite the reduced dynamics, it is preserved by Kertesz.

And still fresh in my memory, though it happened five years ago, is the sight of the stylish L.S.O.'s timpanist managing his sticks like a crack cavalry drummer.

★ ★ ★

SIBELIUS — Symphony No. 2 in D Major. New York Philharmonic Orchestra conducted by Leonard Bernstein. CBS Stereo SBR235357.

Here you have Bernstein at his showiest, and this is simply just not the kind of music to respond to that type of treatment. I have long thought that Bernstein sometimes — but by no means always — tends to Stokowskyism with over-emphatic climaxes, spotlighted soloists, and general exhibitionism. Bernstein's tempos, too, are of dubious authenticity here. Thus although the first movement is marked allegretto, Bernstein starts it almost allegro vivace. Later the movement becomes quite perfervid. There are many pages in the score where Bernstein shows some lack of cohesion in compounding Sibelius' laconic themes. In the record's favour is very forward sound and a truly exciting finale. But then when isn't it? But a strong case against the scherzo can be built on the tempo, which is a joke, not in the original sense of the word as applied to a movement, but in its helter skelter rush. I disliked, too, the trio with the woodwind bleating like a Wurlitzer organ using the tremulant.

For alternative, and to my mind preferably versions, I can recommend the old Anthony Collins and the much more recent Lorin Maazel.

★ ★ ★

BAX — November Woods. A Symphonic Poem.
MOERAN — Sinfonietta.
HOLST — Fugal Overture. World Record Club Stereo S/4631.

My favourite among these three pieces by British composers is the Bax. Indeed it is my firmly held opinion that it is one of the best pieces Bax ever wrote. The scoring and harmonies are rich, the melodic invention never flags. And you will no doubt notice that though Bax uses a very large orchestra the writing is often of the utmost delicacy, setting off the massive, passionate climaxes that surge past from time to time. In listening to it, it must be remembered that the November Woods Bax is evoking in this always picturesque work are English woods and that November in that country is a cheerless month. The leaves have fallen, the air is damp, often foggy, and winter — an English winter — is near at hand.

November Woods might be described as a companion piece to the composer's eloquent Cornish landscaping, Tintagel. It was written around 1917, about the same time as Tintagel and another Bax favourite of mine, The Garden of Fand. Although Bax suffered the usual neglect after his death, there are nowadays signs that a revival of interest in his works is gaining pace. This is not surprising because Bax has much to offer to those who can still respond to full-blooded but always exquisitely restrained romanticism, features that you find in generous abundance in the tone poem under review. It has, too, full symphonic stature and the benefit of a performance by Boult, a long time friend of the composer and perhaps, today, his finest interpreter. I found the whole work, and the playing, vastly enjoyable.

E. J. Moeran was a much more spare composer than Bax. His style was leaner, his scoring more lithe. He lacked the inspiration that came so readily to the latter but made good use of material that was not always out of the top drawer. Moeran used a smaller orchestra than Bax — a quite small orchestra in fact — with wit and elegance. Indeed his argument is often much more interesting than his material. The two first movements have continuing interest; the third I find not so interesting. It smacks rather too much of a cerebral exercise. I think that when his oeuvre is considered the Sinfonietta will be remembered as perhaps his best work. And it receives sympathetic treatment here from Boult and the London Philharmonic. I am not being quite fair when I appear to dismiss Moeran so briefly. A drowning accident cut short what was certainly developing into a distinguished career. The Sinfonietta, by the way, was composed in the early 1940s, a few years before his death.

Holst's Fugal Overture was published in 1923 and heralded a period of comparative austerity after the magnificent exuberance of his Planets Suite, still, in my opinion, one of the finest pieces of music to come out of England during World War I. The Fugal Overture is much more spare, much more frugal, if you will permit a weak play on words. The title might be a little off-putting to those who think of fugues as dull exercises in musical mathematics. It is, of course, fugal in form, but is consistently melodious — a fact that goes far to disguise its formal structure. Altogether a most enjoyable disc though one of perhaps limited appeal.

★ ★ ★

BERLIOZ — Symphonie Funebre et Triomphale. Prelude to The Trojans. Hamlet Funeral March. London Symphony Orchestra and John Aldiss Choir conducted by Colin Davis. Philips Stereo SAL3788.

This is another disc in the Philips' series of the complete works of Berlioz and though the Symphonie Funebre et Triomphale is far from being my favourite Berlioz work I can warmly recommend it. In fact I go as far as to say that no collected edition of Berlioz could conceivably omit it. It was composed to celebrate the tenth anniversary of the July Revolution of 1930 which removed Charles X from the French throne. It is a work of broad effects, massive in conception and execution but smacking a little too much for my taste, of patriotic fervour. The march movement is splendidly spacious if a little on the chilly side, the spirit of which Davis captures to perfection. Then comes the Funeral Oration, a trombone solo, and I never hear it without conjuring up the sight of a doleful busker playing alone outside a pub with his hat in front of him, awaiting small donations. All things considered Davis and the trombonist do all that is possible to tone down its glum implications.

But not even this combination completely overcomes the orotundity of the final Apotheosis, an example of Berlioz at his most inflated. Because of the difficulty in finding players for some of the instruments that Berlioz wrote for — or the instruments either, for that matter — Davis has brought the scoring up to date without any grave damage to the original. And as usual his orchestra play for him as if it is a pleasure. It may not be vintage Berlioz, but no true admirer of that great composer can afford to be without it.

Of the two fills the Hamlet Funeral March is grand Berlioz, majestic, sorrow-haunted — and like so much more of the composer's music, nowadays shamefully neglected. I welcome its inclusion enthusiastically. I cannot say as much for the Prelude to The Trojans at Carthage. It is nowadays never included in the complete version of the two operas on the rare occasions that they are given. I shall be interested to hear whether it has been included in the complete Trojans to be released by DGG in the near future. In the meantime its appeal will be limited to only the most enthusiastic Berlioz fans.

★ ★ ★

STRAVINSKY — Le Sacre du Printemps. Cleveland Orchestra conducted by Pierre Boulez. CBS Stereo 235359.

There have been many excellent recorded performances of this great ballet which is just as much at home in the concert hall as in the theatre or opera house. Stravinsky himself has recorded it twice, and this is also Boulez' second bite at it. Monteux, who conducted its first performance in Paris back in pre-World War 1 days to an accompaniment of catcalls, whistles and fist fights recorded a splendid performance for RCA some years ago. Each time the work has appeared on disc the quality of the sound has always been hailed as something special. Well, with all the best of its predecessors in mind, this new Boulez is, in my opinion, the very best we have had so far. The sound I can only describe as terrific. The individual notes of the many closely packed chords are separated so that each can be heard as never before. The Sacre is a work in which rhythmic treatment is so important that without forceful stressing it loses much of its elemental

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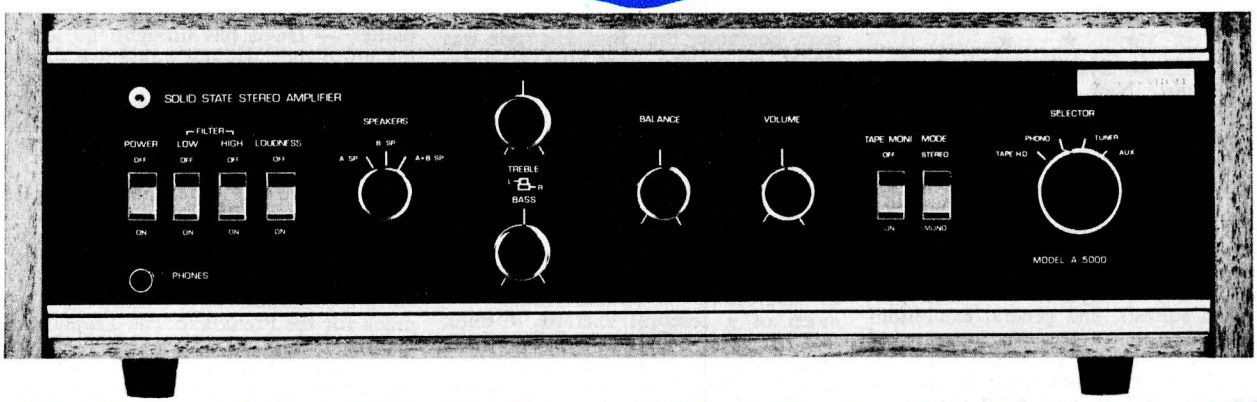

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character. I can say no more than that Boulez' treatment of this aspect is faultless. Those who have become used to Stravinsky's tempos might notice a slight deviation here and there in Boulez' performance. Indeed Stravinsky himself has often commented somewhat surlily on these changes. But I have never been entirely convinced that composers are invariably the best performers of their own works, and I must say that I found all Boulez' tempos eminently acceptable. The Cleveland, drilled for over a quarter of a century by that martinet George Szell, have never played better than they do here under their French conductor. And as I said earlier, the sound is out of this world, to use a cant phrase. I urge you not to miss this thrilling experience.

★ ★ ★

BEETHOVEN — The Creatures of Prometheus. Ballet Music. The Menuhin Festival Orchestra conducted by Yehudi Menuhin. HMV Stereo OASD2515.

Although the Prometheus Overture is fairly well known to most concertgoers this is, to my knowledge, the first time the ballet music has ever been recorded. And even here it is not complete, though it still offers a very good idea of the work's value. This is not always consistent. In ballet music one does not always expect to find a composer's best music — Tchaikowsky and Stravinsky excepted. So that it is while bearing this in mind that I can describe most of the items played by Menuhin and his orchestra as extremely enjoyable if never very profound. The music generally presents Beethoven in an unusually amiable mood with some bars that might even have been written by Schubert. It is so genial a disc and so very beautifully played that it should win a much wider audience than the normal run of Beethoven scholars on the look out for something new from the master. Highly recommended.

★ ★ ★

SHOSTAKOVICH — Symphony No. 5. Philadelphia Orchestra conducted by Eugene Ormandy. CBS Stereo 235355.

This is the type of work in which Ormandy and the Philadelphia are usually heard at their best, and this occasion is no exception. Its intense, often voluptuous contents permit the most expressive treatment. Together with the First Symphony, Shostakovich's Fifth is still his most popular and widely played composition. And despite the composer's reactionary response to the cruel criticism of its immediate predecessors of more original form and content, it has many fine moments — and even movements. It is, too, of true symphonic stature — a form seldom encountered nowadays when miniaturisation and even improvisation are the vogue. But the Fifth, romantic though it undoubtedly is, does not return to the romantic comforts of Tchaikowsky and Rachmaninoff. Its harmonies belong to this century, though not perhaps to its second half. Moreover these harmonies are not just manifestations of the "wrong note" school but form an integral part of the musical thought.

They cover an often demoded syntax with contemporary clothes. These may not be of the type sold in Carnaby Street, but they're not Edwardian frockcoats either.

The symphony is in four movements. The first sombrely thoughtful, the second influenced by the Mahlerian scherzo with landler-like pulse and ironic quotations of popular-sounding tunes. However, the skittishness is never overdone and there is a horn theme that sounds almost Schubertian. The third movement is one of pain-laden introspection and passionate protest. Against what? Shostakovich's earlier artistic excommunication by reactionary Soviet critics and commissars? Only the composer himself knows its secret.

The fourth movement is for the most part martial in character and, as might have been expected, Ormandy and his orchestra make of it a rousing occasion. It builds a magnificent ending to a most impressive performance. I warmly recommend it to all admirers of middle-period Shostakovich, a period Soviet critics might call his redemption from bourgeois tendencies.

★ ★ ★

BEETHOVEN — Piano Concerto No. 5 in E Flat Major (The Emperor). Daniel Barenboim and the New Philharmonia Archestra conducted by Otto Klemperer. HMV Stereo OASD2500.

The March edition of The Gramophone catalogue lists no fewer than 23 different recorded performances of The Emperor. To these, of course, can be added innumerable earlier recordings, some of them excellent, that have since been deleted. Some are fine, a few great, but none, I think, excels this performance by Barenboim and Klemperer. Although Barenboim often uses tempos that are slower than those to which you may have become accustomed the sheer intensity of his musical thought makes this a matter of minor importance. Actually I found many of them increased the emotional intensity of the performance. Nor does Klemperer's characteristically regular beat inhibit Barenboim from introducing many telling inflections in the solo part.

Purists may complain about an occasional smudge in the soloist's technique in the first movement. These could have been easily corrected by simply snipping the tape, re-recording the bars and splicing them in. However, this was not done and I think the performance gains in spontaniety by their retention. It is unusual to hear such a natural happening on a modern disc and I found it refreshing. Perversely so, perhaps, but there it is. I don't think one can name a "finest" performance of the Emperor. But this one is most certainly on the short list.

★ ★ ★

MOZART — Piano Concerto No. 5 in D Major (K.175). Piano Concerto No. 9 in E Flat Major (K.271). with Daniel Barenboim as soloist and conductor of the English Chamber Orchestra. HMV Stereo OASD2484.

Here is another Barenboim recording of quite exceptional merit. It has all the customary Barenboim virtues — spontaneity, technical brilliance, a feeling for just the right tempo, and the ability to inspire his orchestra, the English Chamber Orchestra, with an alertness and sensitivity they award to very few other conductors. The orchestra, by the way, is conducted by Barenboim from the piano. The sound is first class and if I were to go on to enumerate all the highly enjoyable moments in the performances of both these concertos I would end up with only a tiresome list of superlatives. The concertos are, of course, early works. But they are none the less impressive for that reason. It it's sheer delight you're looking for, buy this most attractive disc. ■

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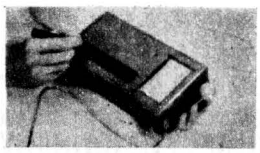

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Devotional Recordings

KEEP ME WHERE LOVE IS. The New Hope Singers, directed by Cam Floria. Stereo, Light Records L S-5 5 0 6-LP. (Available from Sacred Productions Aust., 181 Clarence St, Sydney and other capitals.)

Interest: Gospel group sound.
Performance: Plenty of drive.
Quality: Excellent.
Stereo: Good separation.

The jacket photo shows the New Hope Singers as a group of 13 young people, five of them girls. It shows a pianist, an accordionist, a drummer, two guitarists and nine vocalists. In his notes, Ralph Carmichael says that the group works all the year round, helping to present the Gospel challenge in colleges, shopping malls, service centres and church gatherings.

Their style and sound is in the modern format, intended to capture the interest of other young people. The Gospel songs are modern to match: Keep Me Where Love Is — When You're Young — On Jordan's Stormy Banks — Consider Now The Lily — I Believe God Is Real — I Searched The World — I've Got The Joy You're Looking For — Little Things — The Seed And The Sower — A Better Life.

Intended for young people, the album will find its most obvious audience from their ranks but, at the same time, their parents will find the sound quite easy to live with — which is certainly not true of all group sound. Taken all round, this album should do well. (W.N.W.)

★ ★ ★

THE KINGDOM. Edward Elgar. Margaret Price, Alexander Young, Yvonne Minton, John Shirley-Quirk; the London Philharmonic Choir and the London Philharmonic Orchestra conducted by Sir Adrian Boult. Stereo, World Record Club, two records S/4683, S/4684.

Interest: Fine oratorio.
Performance: Compelling.
Quality: Full and clean.
Stereo: Good basic spread.

After listening to many albums, for this section, of conventional Gospel or youth-oriented Gospel songs, it is an enriching and satisfying experience to review this Elgar oratorio, recently re-released by the World Record Club.

Those versed in classical compositions may need no introduction to the work but I am looking at it here from the viewpoint of readers interested in devotional music, but music of lesser proportions. For such readers, this release has a great deal to commend it. It reflects very strongly those spiritual values which such listeners will appreciate; the musical forms present no problem of familiarity and performance is by vocalists, choir, orchestra and conductor of the highest rank. And, technically, the recording leaves little to be desired, with no surface noise to compromise the recitative passages, and massive, full-bodied sound where it is called for.

The World Record Club has provided generous jacket notes, sufficient to fill both sleeves to capacity with small type.

The first jacket carries a brief introduction by Sir Adrian Boult, followed by extensive notes by Percy Young. These explain the role of the oratorio and then go on to discuss "The Kingdom" in relation to two other oratorios composed by Elgar. He then goes to examine the derivation, the motives and the structure of the work.

On the second jacket, the five parts of the oratorio are stated and identified in relation to the four sides. The words are then given, making it possible for the listener to follow the entire work.

The scenes depicted are: In the Upper Room; At The Beautiful Gate; Pentecost; the Sign of Healing; The Upper Room.

This is a set which I would warmly commend to any who have a potential interest in a work of this nature. (W.N.W.)

★ ★ ★

THE BEST OF SACRED SONGS, 1969 Stereo, World WST-8502-LP. (Available from Sacred Productions Aust., 181 Clarence Street, Sydney and other capitals).

Interest: "Word" Sampler.
Performance: Accomplished artists.
Quality: Excellent.
Stereo: Normal.

We have become so accustomed to whole albums devoted to a single artist or group, that we tend to regard a sampler as something rather odd. This is all the more strange when we recall that programs off the air are usually put together from a variety of sources. No less to the point, one can be reasonably certain that a sampler will not contain any second-rate material.

And there is certainly no second-rate material in this album. The 13 tracks, supplied by well-known Word recording artists and groups, and by the Ralph Carmichael Orchestra, are of Gospel songs which have been popular throughout 1969: Fill My Cup, Lord — Get To Doin' — Healer Of Broken Hearts — He's Got The Whole World In His Hands — He's My Friend— His Sheep Am I — My Friend And I — Nothing Is Impossible — Oh I Never Shall Forget The Day — Psalm 19: The Reflection — the Saviour Is Waiting — Turn It Over To Jesus — Whispering Hope.

Some pleasant singing, a touch of singing strings and a couple of driving guitar numbers to round it off. A well recorded something-for-everyone selection. (W.N.W.)

Instrumental, Vocal and Humour . . .

BIZET'S GREATEST HITS. Various orchestras and conductors. C.B.S. (Australian Record Company) stereo SBR 235358.

Interest: Mainly "Carmen."
Performance: High standard throughout.
Quality: Excellent.
Stereo: Normal.

Bizet's limited output does not allow much scope for a disc of his "Greatest Hits," and it is not surprising to find that the main part of this disc is devoted to the music from "Carmen." The orchestras are those which have been featured throughout this series. The New York Philharmonic under Leonard Bernstein play March of the Toreadors; Seguidille; Micaela's Aria (all from "Carmen"). The Philadelphia Orchestra under Eugene Ormandy play Habanera; Smugglers' March; Les Voici (with the Mormon Tabernacle Choir); Intermezzo; Les Dragons D'Alcala; Danse Boheme (all from "Carmen") — also the L'Arlesienne Suite No. 1 complete, and Farandole from L'Arlesienne Suite No. 2. Andre Kostelanetz and his Orchestra contribute the famous Flower Song from "Carmen" and I Hear as In a Dream from "The Pearl Fishers."

Despite the limited scope of the disc, I found it possibly the best of the series so far. In most of the other releases in the series, I have had reservations about some of the selections, or some of the performances, but I could find nothing to complain about here. Particularly good are "Danse Boheme," which is taken at a spanking pace, and builds up excitement right through until the breathtaking finale; "Les Voici," in which the orchestra and the choir demonstrate a commendable unaminity of purpose, and never falter, despite the fast pace throughout; and the "Flower Song" which is beautifully played by the Kostelanetz orchestra. In all, a delightful disc, featuring some of the finest melodies ever penned, beautifully played, and excellently recorded. (H.A.T.)

★ ★ ★

ECHOES OF ITALY. Werner Muller and his Orchestra. Decca Phase 4 Stereo (E.M.I.) PFS4174.

Interest: Strict tempo style.
Performance: Rigid.
Quality: Excellent.
Stereo: Excellent.

Werner Muller's approach to music has never appealed to me. He is essentially a ballroom musician, and the strict tempo approach which he imposes on everything he plays can become pretty monotonous, if you want music for listening rather than for dancing. There is no denying that he invariably plays attractive numbers, but I fear a lot of people may have been disappointed after they have been attracted by the contents of his discs and the colourful artwork used for the sleeves. If you want Palm Court type music, I do not recommend Werner Muller. On the other hand, if you like ballroom music, this disc has much to recommend it — fine tunes, a very experienced band, and a recording of excellent quality.

The program begins and ends with medleys of well-known Italian tunes, and in between has: Quando Quando—Il Silenzio — Funiculi, Funicula — Love Me Tonight — Arrivederci Roma —La Danza — More — Al Di La — Mattinata — A Man Without Love. If you are not sure whether you like Werner Muller's music, I suggest you ask for a demonstration before making up your mind. (H.A.T.)

★ ★ ★

WINTER WORLD OF LOVE. Billy Vaughn and his Orchestra. Stereo, Dot (Festival) SZL-933728. Also in mono ZL-33728.

Interest: The Vaughan treatment.
Performance: Of a high order.
Quality: Outstanding.
Stereo: Good spread.

Billy Vaughn opens this album with a sound that has built him a large following over the years — rich full melody, highlighted every now and again by his singing sax. But, as the side progresses, the tempo begins more and more to jump. Then, on side 2, things calm down temporarily, jump a bit more, then revert to the "sweet music" formula for the final number.

The program has a modern flavour: Mary Ellen — Raindrops Keep Fallin' On My Head — Winter World Of Love — Come Saturday Morning — Fancy — Yester-Me, Yester-You, Yesterday — Lady-O — Early In The Morning — Theme From Hunger — Holly Holy — Our Dream Of Love.

Technically, the quality is very good indeed: real hi-fi stuff, with lots of close-up bass to give the loudspeakers a workout. (W.N.W.)

★ ★ ★

THE MEDITERRANEAN CONCERTO and other favourites. Semprini, piano, with Melachrino and his Orchestra. Music for Pleasure compatible stereo MFPA 8128.

Interest: Light-music specialist.
Performance: Stylish.
Quality: Some variation.
Stereo: Restricted.

I believe Semprini is better known in the U.K. than here, as he has been regularly featured on radio there, and for several years had his own light-music program. Without being in the same class as Rubinstein or Horowitz, Semprini is an excellent pianist, and is certainly one of the best performers in his chosen field of light classics. His program here begins with his own composition, "The Mediterranean Concerto," from which he plays the principal theme. Then follows theme from "The Last Rhapsody" (Wreford), "The Story of Three Loves" (Rachmaninoff), and the Grieg Piano Concerto. Side two begins with an arrangement for piano and orchestra of Liszt's "La Campanella," then follows his only piano solo, Chopin's "Fantasy Impromptu." Finally, there is a lengthy selection from Bernstein's "West Side Story." The sound quality tends to vary between tracks, and in some the piano tone sounded shrill, but this is improved by cutting the treble back. (H.A.T.)

★ ★ ★

TOTAL STEREO. Various orchestras. Universal Record Club stereo U1044.

Interest: Mixed.
Performance: Varied styles.
Quality: Good recording.
Stereo: Good spread.

This is a rather mixed bag, comprising tracks by seven orchestras. There is considerable variation in the style, ranging from a big band swinging style (Frederick Klein orchestra) to the smooth as satin sound presented by Felix Slatkin. Klein has four tracks: If I Were a Rich Man — Laila's Dream — Lara's Theme — Love is Blue. The hard, unsentimental approach to these essentially sentimental numbers did not appeal to me, nor can I imagine they will to anybody who appreciates the style exemplified by Felix Slatkin, who presents pleasant versions of "Meditation" and "Love is a Many Splendoured Thing."

Also on the rowdy side are: Hang 'Em High (Paul Nero Sounds) — Lonesome Road; Sukiyaki (Si Zentner) — Negresco (Klaus Doldinger) — The Total Eclipse (Hi-Heel Sneakers). The remaining track, Martin Denny's version of "The Girl from Ipanema" is another gentle swinger which will appeal to those who favour the Felix Slatkin style. A disc with too much mixed interest to be really successful, I feel. (H.A.T.)

Polonaises of Chopin

THE FAVOURITE POLONAISES OF CHOPIN. Philip Entremont, piano. C.B.S. (Australian Record Company) stereo SBR 235356.

Interest: Popular piano classics.
Performance: One of his best.
Quality: Well recorded.
Stereo: Not significant.

Till now, Entremont has seemed to me to be rather a showy pianist who can display plenty of fire and brilliance but determinedly stifles any tendency to sentimentalising. I was therefore a little surprised by his approach to these polonaises, which is distinctly lyrical and almost easy going. To my mind, a degree of romanticism is essential in performances of the music of Chopin, and I have missed this element in earlier Entremont recordings, but now, for the first time, he achieves what to me is the ideal balance. The familiar Entremont dash and fire are there in the right places, but so is a new depth of feeling where it is required. Absolutely clean fingerwork, some finely judged rubato, and an exemplary control of touch are present throughout, all adding up to a fine performance.

Besides the inevitable A major ("Military") and A-flat major ("Heroique") polonaises, there are the C-sharp minor, Op. 26, No. 1; E-flat minor, Op. 26, No. 2; C minor, Op. 40, No. 2; and F-sharp minor, Op. 44. The last-named is my particular favourite among the Chopin polonaises, and if I experienced a slight pang of disappointment in Entremont's performance, it was no doubt because still fresh in my memory is the wonderful Horowitz performance in his disc "Horowitz on Television." (H.A.T.)

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TONY FENELON GOING PLACES

TONY FENELON IN AMERICA. Wurlitzer organ, live in concert from the Senate Theatre, Detroit, U.S.A. Stereo, Festival SFL-933,-755. Also in mono FL-33755.

Interest: Guest organ recital.
Performance: Fantastic.
Quality: Real sound, real atmosphere.
Stereo: Essential for proper appreciation.

For this recital, Tony Fenelon was the guest of the Detroit Theatre Organ Club. At his disposal was one of the finest ever examples of the Wurlitzer genius — a 4 manual, 34-rank organ, with an extensive range of effects and a full-scale remotely controlled grand piano standing beside the organ console.

Originally installed in the huge Fisher Theatre in Detroit in 1928, the instrument was purchased by the Detroit Theatre Organ Club, installed in another theatre, and then reinstalled in its present location, the disused 1400-seat Senate theatre. Theatre and organ alike were refurbished and are maintained in immaculate condition for round-the-clock use of Club members.

With the chambers disposed behind the main curtain and to either side of the procenium, the instrument is eminently suitable for recording in stereo and, as I have observed above, the stereo spread of this very well recorded album is essential for a full enjoyment of the performance.

And what a performance. If you have been impressed by the slickness and facility of George Wright, Reginal Dixon and others who have been at the game for a long time, you're due to be impressed all over again by this new recital by Tony Fenelon. It's pure theatre organese, to be sure, but the artist's early training as a classical pianist shows through, both on the organ voices, and in his handling of the remotely controlled piano. And remember, his encounter with this instrument and its highly complex console could only have been a passing one.

The track titles: Overture to "George M." — Someone To Watch Over Me — Twinkle, Twinkle, Little Star — I'm Confessin' — South — The Breeze And I — Broadway Melody (Medley) — As Long As He Needs Me — Voices Of Spring — Now Is The Hour.

How does this album compare with the Crest release? It's a bigger occasion on a bigger instrument. Which should you buy? If you're a Wurlitzer organ fan — both of them! (W.N.W.)

★ ★ ★

MORE TONY FENELON. At the Mighty Regent Wurlitzer. Compatible stereo, Crest CRT-12-SLP-026. (From Sound and Film Enterprises of Aust. Pty. Ltd., 291a Tooronga Road, Tooronga, Vic. 3146).

Interest: Farewell to famous organ.
Performance: In best cinema traditions.
Quality: Excellent.
Stereo: Used to advantage.

My phrase "farewell to famous organ" is prompted not by anything on the jacket but by the knowledge that the instrument has now been dismantled, some day to be reinstalled in a building which could hardly be as commodious as Melbourne's huge Regent theatre.

But this album does not rely on any kind of sentiment to justify its purchase. There's nothing in it to suggest that many long years have passed since the instrument was first installed.

Nor is there anything in the performance to suggest that the player is far too young a man ever to have known, in their prime, the generation of organists who once entertained theatre patrons right around Australia.

But, as I have already indicated, this recital loses nothing even by nostalgic comparisons. The tracks you'll also like: The Continental — These Foolish Things — A Man And A Woman — Lara's Theme — What's New — Stranger in Paradise — It's De-Lovely — Camelot — More — Oklahoma Selection (6 titles, 11 minutes).

Local theatre, local organist, local recording — a good one (W.N.W.).

FOOTNOTE: A Press release from Festival Records indicates that Tony Fenelon has received a rare honour for an artist in his field. He was invited to give a combined piano and popular theatre organ concert, during June, in the Grand Hall of the former John Hayes Hammond Castle in Gloucester, Massachusetts, U.S.A. The organ in the Grand Hall is a 4-manual 144-rank instrument and is considered to be one of the most magnificent instruments of its kind in the world. Selection was made after the Castle Fine Arts Committee heard a recent recording by the young artist and considered it to be "the finest ever recorded."

MORE ROS ON BROADWAY. Edmundo Ros and his Orchestra. Stereo, World Record Club W.R.C. S/4616.

Interest: Broadway, Latin-style.
Performance: Bright.
Quality: Very clean.
Stereo: Plenty of separation.

A truly international effort, this: From the Edmundo Ros Club in London, the Orchestra plays the melodies of Broadway in Latin style. Whether Rogers, Loewe, Berlin and Co. ever thought of their compositions in this role is of no consequence; the Ros percussion lays down the basic rhythm and the melody has no choice but to go along!

And the melodies you'll certainly know: The Surrey With The Fringe On Top — I've Grown Accustomed To Her Face — C'Est Magnifique — This Nearly Was Mine — I Got The Sun In The Morning — Just In Time — How Are Things In Glocca Morra? — The Carousel Waltz — Wish You Were Here — You're Just In Love — If I Loved You — Shall We Dance.

The sound is certainly bright. It's a question of whether you prefer them this way or the more usual big band treatment. (W.N.W.)

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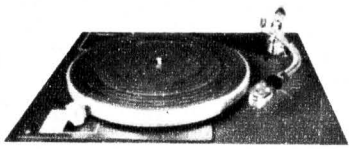

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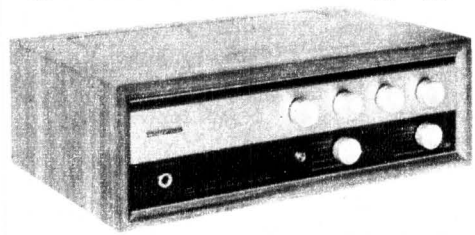

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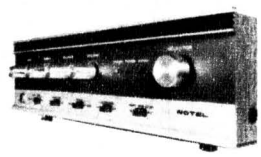

A brand new amplifier incorporating semi-complementary single-ended push pull OTL (output transformerless) circuitry, the Rotel 100 is fast becoming a best-seller at Challenge Hi-Fi Centre. Power output is 15 watt r.m.s. per channel into 8 ohms, and harmonic distortion is a low 0.4% at 10 watts r.m.s. Frequency response is 25-20,000 (plus or minus 1½db). Sensitivity for magnetic cartridge is 3 millivolts. The Rotel 100 boasts many features normally found only on much more expensive amplifiers and includes tape monitor circuit, selector switch for two sets of stereo speakers, loudness contour circuit and attractive input selector indicator lights on the front panel. Price $109.00.

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EMPIRE 1000ZE. Compliance 35 x 10 -6 cm/dyne, tracking force ¾ gram, frequency response 4-40.000Hz, separation 35db, output 4mv per channel, hand-polished 0.2 x 0.7 mil elliptical diamond. $100.00.

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EVERYBODY'S TALKIN'. The Exotic Guitars. Rainwood (Festival) stereo SFL-933663. Available in mono.

Interest: Mood guitar.
Performance: Relaxed style.
Quality: Good standard.
Stereo: Normal.

This disc floats dreamily from tune to tune, its soporific mood guaranteed to smooth the wrinkles from your brow at the end of a tiring day — in other words, it is mood music to relax to with the lights down low. No details are given of the personnel, apart from the nomination of Al Casey as lead guitar, but the group appears to consist of acoustic guitar, electric guitar, woodwinds, percussion and bass — no strings or brass. The tunes are a mixture of old and new: Everybody's Talkin' — Love Theme from "Romeo and Juliet" — Smile A Little Smile for Me — Ebb Tide — Jean — To Rome with Love — Midnight Cowboy — Peg O' My Heart — I Was Kaiser Bill's Batman — Now Is The Hour — Sugar, Sugar — Release Me. If you like guitar, and are looking for some music for periods of relaxation, this one is worth investigating. If you want to sample before buying, try "Jean" on side one, and "Now is the Hour" on side two. (H.A.T.)

★ ★ ★

LATIN BEATLES — The Mirza Men. Universal Record Club, Stereo U-1032.

Interest: Big L/A Band.
Performance: Well played.
Quality: Bright, clean recording.
Stereo: Good balance.

Mr Mirza is, apparently, a specialist in Latin American percussion who was born in Bahrain and now resides in London. Be that as it may, the Mirage Men turn out to be a collection of top English session-men including a heavy battery of bongos, congas, timbales, maraccas, guiros and the rest.

The album is pleasant enough with the twelve Beatles' tunes standing up well to the relentless, percussive L/A treatment. The titles are well enough known and they include "Michelle," "A Hard Day's Night," "Can't Buy Me Love," "Yesterday," "Eleanor Rigby," and "Norwegian Wood."

The musicianship is very accomplished and the brassy arrangements are well scored, but in the end the solid L/A percussion tends to become tedious.

Nevertheless, this LP should be an attractive purchase for Universal Record Club members whose musical tastes veer towards Latin American. The playing-time is 33 minutes. (T.F.C.)

★ ★ ★

MOOD FOR LOVE — Acker Bilk with Leon Young String Chorale. World Record Club Stereo S/4620.

Interest: Late night listening.
Performance: Easy and relaxing.
Quality: Well recorded.
Stereo: Even spread.

This World Record Club re-issue features the warm, sultry clarinet of Acker Bilk on a well-balanced selection of "midnight" songs.

With the beautifully-tuned strings of the Leon Young Chorale, Acker strolls nostalgically through romantic ballads like "I'm In The Mood For Love," "Confessin'," "Paradise," "When Lights are Low," "It Had To Be You," "If I Could Be With You" and "When Your Lover Has Gone." The music is predictable but never dull with the high quality of the material, the superb musicianship of Acker Bilk and the lush arrangements by Leon Young.

Club members will find that the 34 minutes of music on this LP are ideal for relaxed, late-night listening. (T.F.C.)

★ ★ ★

ROBERT LEEMAN PLAYS THEME FROM "A SUMMER PLACE" and other tunes. Robert Leeman, harmonica. Australian recording by Australian Record Company. C.B.S. Stereo SBP 233789.

Interest: Australian harmonica player.
Performance: World class.
Quality: Good standard.
Stereo: Normal.

When Robert Leeman made his first LP (for W. and G.) three years ago, he was virtually unknown outside his

Mayall Blues . . . "superb"

BLUES BREAKERS — John Mayall. Decca (EMI) Stereo SKLA 4804. (Also available in mono.)

Interest: Mayall's best group.
Performance: Superb.
Quality: Well recorded.
Stereo: Poor balance.

This John Mayall LP has been available in Australia — in mono only — for more than a year. Most Mayall collectors will therefore be thoroughly familiar with this superb album.

For most of the 1960s, Mayall has been the spiritual leader of the English blues movement — a talented, dedicated musician and composer, ever searching for the essence of blues expression. During this time, he has led many bands and employed countless musicians in his efforts to find the sound he wants.

This particular group, from around 1965-66, with Eric Clapton, John McVie and Hughie Flint was, I think, his finest group, mainly because of Clapton's brilliance. On tracks like "All Your Love," "Hideaway," and "Steppin' Out," for example, the guitar solos are outstanding and far more meaningful, I suggest, than much of his subsequent work with Cream.

Apart from composing five of the tracks, Mayall takes all but one of the vocals (Clapton and Robert Johnson's "Ramblin' On My Mind") and he is also featured on harmonica on "Another Man" with Rose Allison's standard "Parchman Farm." On three tracks, Alan Skidmore (tenor), Johnny Almond (baritone) and Dennis Healey (trumpet) are added to the group but the horns are used mainly to provide ensemble colouring for Mayall's organ.

If any collectors of English blues have not already heard this classic LP, they should do so without further delay. (T.F.C.)

home city of Melbourne. Within the last 12 months he has become much more widely known from his appearances in the popular Showcase television program. I was able to give a warm recommendation to his first disc, but I can go even further here, and say that the standard of playing on this disc is outstanding, and places Leeman among the great performers on the harmonica. He exhibits wonderful dexterity in the faster pieces, such as Chopin's "Minute" waltz, and Mozart's Turkish March, a jaunty strut in such pieces as Two Guitars and Donkey Serenade, and an appealing approach to the more soulful numbers, such as Claire de Lune, Tristesse, and Exodus. A highlight is his abbreviated version of Ponchielli's Dance of the Hours, the piece which won him a prize in the 1969 Showcase final.

Also included in the program are: Theme from "A Summer Place" — Tammy — Ebb Tide — La Mer. It is perhaps worth mentioning that when I played this disc at a gathering of people with widely differing tastes, it won universal approval, and several people who heard it have since bought it. (H.A.T.)

★ ★ ★

IT HAD TO BE YOU. Wilbur Kentwell. Stereo, RCA Camden CAMS-153.

Interest: Organ dinner music.
Performance: Competent.
Quality: Normal.
Stereo: Not all that important.

The jacket of this latest Wilbur Kentwell album is singularly uninformative, with no attempt to identify the artist, the model of the instrument, the locale or who (or what) provides the percussion background. One would assume, however, that the recording was made in Brisbane and probably at the studios of TV Channel 0 in Brisbane, of which station Wilbur is musical director.

The label does mention a Conn organ, probably the theatre model featured on the last album, but the nature of the voicing and percussion suggests that a couple of the tracks, at least, might have been done on another instrument.

Be that as it may, the artist leads off with organ plus percussion, but follows it with a straight organ solo. Thereafter, percussion and straight organ alternate through the rest of the album, avoiding the risk of monotony which an all-percussion album can involve. The quieter numbers are played smoothly enough, but, in other tracks, particularly in the rhythmic passages, Wilbur pulses the expression pedal more obviously than any other organist I can recall. It is apparently quite deliberate, but many may consider it overdone.

In a quite generous program of over 40 minutes, you get: Just In Time — As Long As He Needs Me — Brazil — People — Puppet On A String — Ebb Tide — It Had To Be You — Lover Come Back To Me — How Are Things In Glocca Morra — Sweet Georgia Brown.

For those who like the organ, this should be very acceptable sound, played at modest level, as a background to dining or relaxation. (W.N.W.)

GUITAR HIT KIT. Tommy Rodgers and his Trick Guitar. Universal Record Club compatible stereo U-1043.

Interest: Guitar travelogue.
Performance: High standard.
Quality: Excellent.
Stereo: Well spread.

While I do not like the appellation "trick guitar" for a perfectly straightforward performance such as we have here, I did find this a very enjoyable disc, featuring some first rate guitar playing, nicely backed with some skilful rhythm and percussion, and a program with a distinctly international flavour: Steel Guitar Rag — Anna Baion — Napoli Melody — Dark Eyes — Dilcado — Wheels — Tico-Tico — Apache — Brasilian Holiday — Harry Lime Theme — Mexican Hat Dance — Happy Mandolin. The disc originates from the catalogue of Vogue Records, Germany, and is of excellent quality. (H.A.T.)

★ ★ ★

FANTASTIC — The 5th Dimension. Universal Record Club Stereo U1038.

Interest: Fabulous vocal group.
Performance: First-rate.
Quality: Well recorded.
Stereo: Excellent separation and balance.

The 5th Dimension is, I think, the most talented and exciting vocal group on the scene today. In the space of two years or so, they have scored enormous successes with their recordings, TV shows and night club appearances.

This Universal Record Club release includes tracks from their early albums and the collection is absolutely first-rate. Several of their big hits are featured including "Up Up And Away," "Sweet Blindness" and "Stone Soul Picnic." Some of the other outstanding tracks are "California My Way," "Go Where You Wanna Go," "California Soul," "The Magic Garden" and "Ticket To Ride."

All the recordings by the 5th Dimension have been distinguished by first-class backings, production and material. On this LP, for example, four of the songs were written by Jim Webb and two by Laura Nyro. This album represents exceptionally good value for club members. (T.F.C.)

★ ★ ★

HERE WHERE THERE IS LOVE — Dionne Warwick. Scepter Records (Festival) Stereo SJL 932165.

Interest: Mainly old recordings.
Performance: Unexciting.
Quality: A bit flat.
Stereo: Normal separation.

Despite her rare talent, Dionne Warwick is in danger of releasing too many unexceptional records too often. This LP, for example, includes 10 tracks, of which only a handful are new recordings.

Six of the songs, not surprisingly, are Bacharach-David compositions including the well-worn "What The World Needs Now Is Love," "Trains And Boats And Planes" and "Alfie." However, the title track is a new recording in the best Warwick tradition.

The remaining tracks are, again, familiar songs like Lionel Bart's "As Long As He Needs Me," "I Wish You Love" and Bob Dylan's "Blowin' In The Wind."

As I indicated earlier, Dionne Warwick is a superb artist but albums like this do her little credit. Particularly in view of the playing-time of 27 minutes, this LP can safely be ignored. (T.F.C.)

★ ★ ★

LENA IN HOLLYWOOD — Lena Horne. United Artists (Festival) Stereo SUAL 932403. (Also in mono.)

Interest: Great singer.
Performance: Worth hearing.
Quality: Well recorded.
Stereo: Normal separation.

In these days when younger singers like Nancy Wilson and Shirley Bassey tend to command the spotlights, fine artists like Lena Horne and Peggy Lee are often forgotten or at least neglected. This new LP by Lena Horne should serve as a reminder that she is an outstanding artist by any standards. Her voice is vibrant and personal, she swings both in ballads and up-tempo numbers, her phrasing and diction are impeccable and she has the ability to revitalise even the most hackneyed of standards.

On this album she sings a selection of well-known songs from motion pictures like "Singin' In The Rain," "Never On Sunday," the beautiful "Somewhere," "All The Way," "Moon River" and "I Love Paris." The arrangements by Ray Ellis are sympathetic and beautifully played. Despite the poor playing-time of 31 minutes, this album is well worth hearing. (T.F.C.)

★ ★ ★

NATURALLY — Nancy Wilson. World Record Club S/4621.

Interest: Exciting singer.
Performance: Excellent.
Quality: Bright recording.
Stereo: Well balanced.

As regular readers of these columns will know, I am an ardent enthusiast of Nancy Wilson's singing. She displays superb feeling for a song, whether it's

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up-tempo, a ballad or a blues number. On this WRC re-issue, which was probably recorded some three or four years ago, she is backed by the Billy May Orchestra and the results are well up to Miss Wilson's usual high standard.

The tracks are skilfully balanced and include swingers like "Alright, Okay, You Win," "Smack Dab In The Middle," "Aint That Lovin' You" and Willie Dixon's "My Babe." As usual, Nancy Wilson is at her best in good, bluesy ballads like "Just For A Thrill," "I Wish I Didn't Love You So," and Lil Green's classic, "In The Dark."

The two outstanding tracks on the LP are probably Michel Legrand's beautiful song "Watch What Happens" and the old standard "Willow Weep For Me."

Although the playing-time is a bit light at 32 minutes, this album is recommended to all members of the World Record Club who enjoy Nancy Wilson's superb singing. (T.F.C.)

★ ★ ★

FESTIVAL OF MASSED WELSH MALE VOICE CHOIRS. 100 voices in song in the Royal Albert Hall, October, 1969. Conductor, Roy Bohana; Organist, Tudor Spencer Davies. Stereo, Columbia, SCXO-6378.

Interest: Notable choral occasion.
Performance: Magnificent.
Quality: Virtually flawless.
Stereo: Smoothly spread.

The jacket notes suggest that changing social conditions are undermining the kind of interest which brought together no less than 12 Welsh choirs for this huge vocal festival, held last year in the Royal Albert Hall.

If, in fact, last year's festival proves to be the last on such a scale, this album is a worthy and fitting memento of a passing era. From the massed voices, the conductor has won a most notable degree of sympathy and response, ranging from delicate shadings to moments of tremendous climax. Some may feel that the applause overwhelms the closing phrases of each number but it is the response of an audience no less enthusiastic and no less involved than the members of the choir itself.

The track titles: National Anthem — Serenade (From The Fair Maid of Perth) — O Isis And Osiris — Pilgrims' Chorus—Chorus Of The Hebrew Slaves—Soldiers' Chorus—Silver Birch — Battle Hymn Of The Republic — Laudamus — Tydi A Roddaist — Deus Salutis — Ar Hyd Y Nos — Men Of Harlech — Cyfri'r Geifr — Myfanwy — Cwm Rhonda — Hen Wlad Fy Nhadau.

If you enjoy choral music, you'll certainly enjoy this album (W.N.W.)

★ ★ ★

THE WORLD OF GEORGE FORMBY. Stereo, Decca SPA-50, Series 250.

Interest: Old-time comedy songs.
Performance: Good in its day.
Quality: Restricted range but clean.
Stereo: Simulated, purely nominal.

To listen to this record is to flip back in time by thirty or more years, to the days when items by George Formby took their turn on the radio with contributions by Bing Crosby, Peter Dawson and Jesse Crawford.

Heard singly in those days the numbers rated pretty well. Heard, thirty years later, a dozen in a row, the sameness of the style and sound is tediously evident. But played occasionally in the right atmosphere, the slightly "naughty" lyrics should still be good for a giggle and bit of reminiscing.

Remember these? When I'm Cleaning Windows — Why Don't Women Like Me — You Can't Keep A Good Lad Down — Swimmin' With The Wimmin' — The Old Kitchen Kettle — My Little Ukelele In My Hand — Chinese Laundry Blues — Sitting On The Ice — Running Round The Fountains — Fanlight Fanny — It's No Use Lookin' At Me — Leanin' On A Lamp Post. (W.N.W.)

Johnny Cash . . . "one of the best"

JOHNNY CASH 1970. Music For Pleasure Gold Edge Series ($3.98) compatible stereo Gold 0001.

Interest: C. & W. star.
Performance: One of the best.
Quality: Fine.
Stereo: Compatible.

This is the much promoted disc which heralds Music for Pleasure's entry into a higher price bracket. The massive advertising campaign launched to bring this product before the public has ensured that just about every person who watches television will know of its existence, and will have some idea of what it contains. Sales are expected to run into millions in Australia, and I doubt whether any person who buys this disc will be disappointed. It is certainly one of the best and most entertaining C. & W. discs to come my way in many a long day. Johnny Cash's deep resonant voice comes over very well in this recording. In fact, one has the impression that the bass end has been raised a few dBs and, with good quality equipment, it may be necessary to cut your bass control back a bit further than its normal setting. The 12 tracks are: Nine Pound Hammer — Lorena — The Long Black Veil — When Papa Played the Dobro — I Still Miss Someone — Ring of Fire — Bad News — The Streets of Laredo — Don't Think Twice, It's Alright — Frankie's Man, Johnny — I Walk the Line — Folsome Prison Blues.

The disc is packaged in an attractively designed book-fold type jacket, with numerous photos of the artist, and lyrics for "Folsome Prison Blues" and "The Streets of Laredo" on the back. The tracks have been carefully culled from the hundreds Johnny Cash has made in his long career, but although some of them must be quite old, the sound quality is uniformly excellent throughout — a tribute to the engineers who prepared them for this issue. (H.A.T.)

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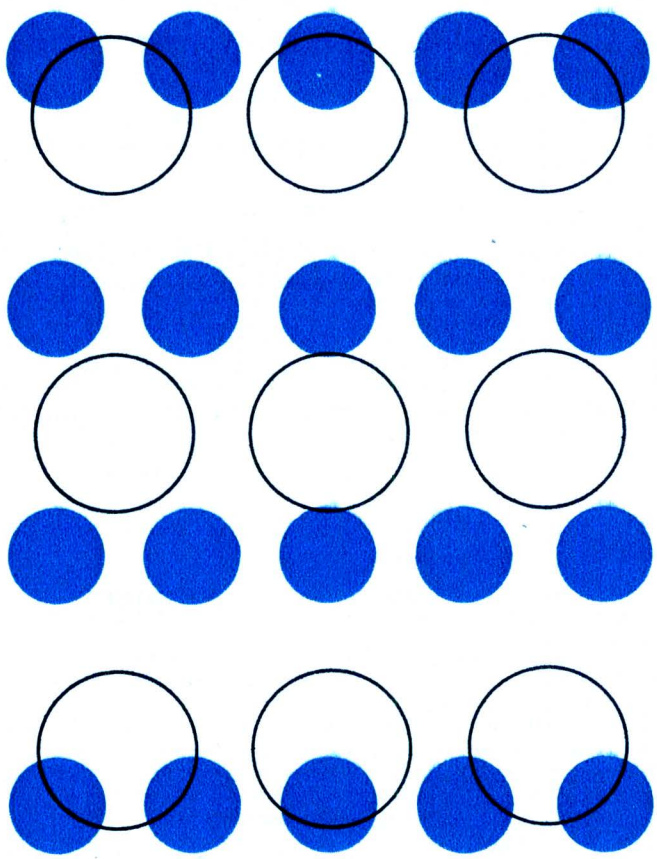

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I've got music — "jolly good buy"

I'VE GOT MUSIC. George Blackmore plays the theatre organ. Stereo, Columbia SOEX-9467.

Interest: Pipe Wurlitzer and Compton organs.
Performance: Thoroughly pleasant.
Quality: Good.
Stereo: Normal.

George Blackmore F.R.C.O. began his organ playing career in a cathedral but, while still only 18, succumbed to the lure and the glamour of the theatre console. As well, since 1941, he has featured regularly on British radio.

During the course of a concert tour of Australia and America in 1967, George Blackmore opened the newly installed Wurlitzer in Melbourne's Dendy theatre, an occasion at which many readers may well have been present.

For this program he uses two very well known organs in England — The big 4-manual Wurlitzer at the Gaumont State theatre at Kilburn, and the even larger 4-manual Compton at Southampton Guildhall.

With the facility of long experience and without ostentation he plays a thoroughly pleasant program: Raz-A-Ma-Tazz — Estrellita — I Got Rhythm — Flamingo — Latin Lady — Butterflies In The Rain — One Of Those Songs —Bond Street Rag — Cecilia — Jenny — Porto Rico — Stranger On The Shore — America Marches.

For $2.50 this is a jolly good buy. (W.N.W.)

BUSH GIRL. Shirley Jacobs, vocals, with Ade Monsbrough, recorders and melodica; Mike Hayes, 6 and 12-string guitars; Peter Hayes, 5-string banjo; Allan Pope, string bass. Crest stereo CRT12/SLP025. (Sound and Film Enterprises, 291a Tooronga Rd., Tooronga, Vic. 3146.)

Interest: Australian folk singer.
Performance: Pleasant.
Quality: Very good.
Stereo: Normal.

Apart from the delectable Tina Date (who, alas, has apparently deserted us for good for the greener entertainment pastures overseas) Australia has few really good female folk singers. Of these, Shirley Jacobs would be one of the best. Here she has recorded an all-Australian selection: Van Diemen's Land — Maggie May — Moreton Bay —Lady Franklin's Lament — Cross of the South — Death of Ben Hall — The Old Palmer Song — The Catalpa — Stringybark Creek — Clancy of the Overflow — Reedy River — The Bush Girl — The Waradgery Tribe — The Route March. Assisted by a small group of very competent local musicians, and accompanying herself on six and 12-stringed guitars, Shirley acquits herself very well in this by no means easy program. Some of the old traditional songs present no problems, but the settings of the poems of Henry Lawson, Banjo Paterson and Dame Mary Gilmour require more than just a nodding acquaintances with the elements of music.

It is unfortunate that this disc had to be issued in the wake of the flood of inferior material put out in connection with the Cook Bi-centenary celebrations, as it is worth its place in record collections on its own merits. Miss Jacob's warm voice is well suited to the material, and the arrangements and instrumental support are excellent. (H.A.T.).

★ ★ ★

SUNSHINE POSSIBILITIES. The Famous Jug Band. Liberty (Festival) stereo SLYL-933,559. Available in mono.

Interest: Unusual folk group.
Performance: Very pleasant.
Quality: Excellent recording.
Stereo: Normal.

The Famous Jug Band make some very pleasant noises in this, presumably their first, disc. In a group of folk oriented songs, they accompany themselves with guitar, banjo and, of course, the jug. In case you have never seen or heard a jug being played, I should explain that it is a kind of large bottle, which the performer plays by blowing across the top. By manipulation of either his lips (or fingers, or both, I am not sure quite how) he produces a range of sounds remarkably like those of a bass player. The group has the decided advantage of a female lead singer with a strong clear voice which does for the group what Judy Durham did for The Seekers — she gives it personality.

Most of the songs are new to me, but for the record, here are the titles: Can't Stop Thinking About It —Nicholson Sq. — He Never Came Back — A Leaf Must Fall — Shaky Train Blues — The Only Friend I Own — Black is the Colour — Saro Jane — Train on the Island — The Main Thing — Breakfast Blues — Sunshine Possibilities. The recording is of excellent quality, clean and bright with no noticeable distortion. (H.A.T.)

★ ★ ★

PARIS FOR LOVERS. Maurice Larcange (accordion) with the Claude Martine Orchestra and Chorus. Phase Four Stereo (E.M.I.) PFS 4168.

Interest: French accordion music.
Performance: Overdone.
Quality: Excellent.
Stereo: Good.

This should have been a very good record, since it features one of the world's leading accordion virtuosos, and has the benefit of Decca's superb Phrase 4 Stereo sound—yet it does not quite come off. The main trouble is that Maurice Larcange is not allowed enough scope to develop his art, being almost submerged in a too lush orchestral and choral backing. The light musette style of playing which is best suited to the accordion cannot support such a top heavy load, and the result is that the soloist is almost smothered by it. One has only to contrast this disc with the delightful Vogue disc featuring Aimable to confirm the right and the wrong way to present this type of material. As rather featureless background music this disc is pleasant enough, but I do not recommend it to accordion fans. The 12 tracks include such pleasing melodies as: At Last — The Windmills of Your Mind — Milord — L'Absent — The Three Bells — If You Go Away. (HA.T.). ◘

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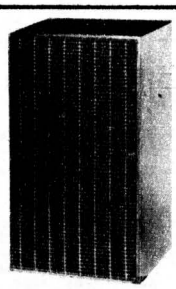

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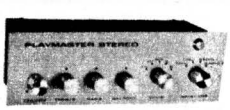

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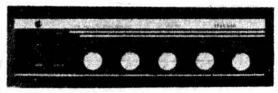

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Synchronisation Devices Internal (Positive and Negative, External).
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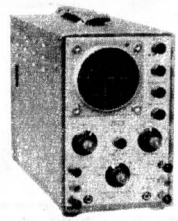

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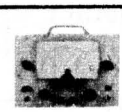

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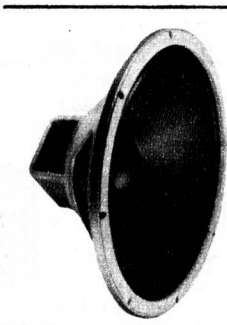

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TRADE REVIEWS AND RELEASES

A.W.A.'s new range of amplifiers

The new range of high quality amplifiers from Amalgamated Wireless (Australasia) Ltd., will be of great interest to stereo enthusiasts. Manufactured in Wellington, New Zealand, they are comparable in performance to the best amplifiers from more remote sources. In addition, since they are manufactured in our corner of the world, comprehensive service facilities are available, should this be necessary.

Four units from the A.W.A. range were submitted by the Consumer Prolucts Division of A.W.A., as follows: ST 953 tuner/amplifier, ST 95 and ST 45 amplifiers and the AM3 wideband AM tuner. The ST 45 and ST 95 amplifiers are identical in appearance and circuitry, except that the ST 95 uses different output transistors and a higher DC supply voltage to achieve higher power output. The ST 953 tuner/amplifier is a combination of the ST 95 amplifier and the AM3 tuner.

Since time did not permit a complete test of each separate unit, we decided to base our evaluation on the performance of the ST 953 tuner/amplifier. All the units have the same construction technique and many of the printed boards are common to each unit. The following remarks on the ST 953 can be applied, in general, to all of the units submitted for review.

The ST 953 is physically quite large, having dimensions 18 x 13 x 5¼in and weighting 19lb. The styling can be described as handsome, which fairly obviously means that this reviewer liked it. The front panel is made of extruded aluminium sections with a satin finish and the dial is black. The knobs are black plastic with aluminium caps, while the push-buttons have chrome caps. Overall finish is immaculate.

The construction of the case is simple and sturdy. Two teak-finished ends are screwed to suitably folded sheets of Lysaght Marviplate which make up the top and bottom. The rear portions of the sheets are perforated to allow ventilation. Four screws are removed to slide the amplifier out of the case.

The internal layout of the amplifier is unique in that it is based on a perimeter chassis, i.e., the chassis is of open construction and one can work from either side. This enables easy access to both sides of the main amplifier boards and the "mother" board, into which the pre-amplifier boards are plugged. In fact, we have to hand it to A.W.A. for designing possibly the most easily serviced amplifier we have yet seen.

The tuner is inductance-tuned, using what appears to be the tuner module from locally designed A.W.A. manually tuned car radios. The tuning movement is very smooth but is not flywheel assisted.

Features we particularly liked were as follows: The four power transistors mounted on the rear of the chassis were protected by a cover so that they could not be inadvertently shorted with a screwdriver or other implement. All the input sockets were DIN sockets which halves the number of leads. DIN connectors are also somewhat easier to connect and disconnect than the usual phono connectors. The DIN sockets are mounted directly on a printed board at the rear of the amplifier. This board also accommodates one of the wafers of the equalisation switch, which is shielded from the rest of the amplifier circuitry by a vertical aluminium plate.

The power transformer is a compact C-core type, which is fitted with a copper strap to minimise flux leakage and consequent hum induction to the surrounding circuitry.

Two of the features we did not like are outlined as follows: The tuner module was not rigidly mounted but was able to twist around the tuning spindle bush. This means that a heavy-handed user or a mischievous child could twist the assembly when the pointer is at either end of the dial so that the dial calibration could be affected. Revised mounting and a flexible coupling would probably help although it may be argued that no piece of equipment is entirely proof against a determinedly ham-fisted user.

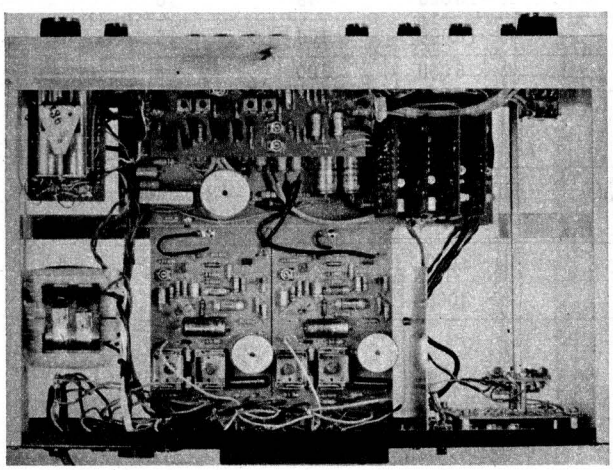
The other point concerns the push-buttons. Because of lack of clearance from the front panel, relative to side-play, the push buttons are likely to become scored after being used a few times. Perhaps this would not be so noticeable if glossy plastic was not used.

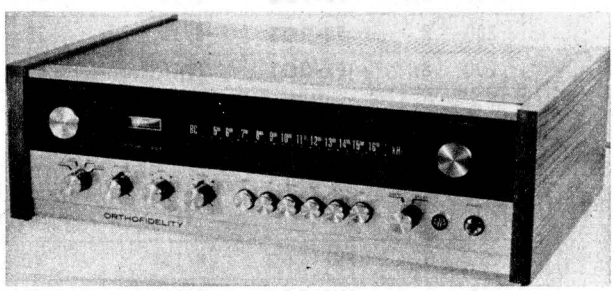
Circuit design of the amplifier is largely conventional, but features several departures from usual practice. The input stage consists of three NPN transistors connected in a direct-coupled feedback arrangement which provides equalisation for magnetic and ceramic cartridges, auxiliary and tape inputs. The auxiliary input is intended for microphones — it has a sensitivity of 10mV for full power into 8-ohm loads. This pre-amplifier has very good overload capability. A.W.A. claim an overload capability of over 20 but in practice we found it to be closer to 28, so that the magnetic cartridge input, which had a sensitivity of 4mV for full power into 8-ohm loads, was able to handle a 110mV sigal at 1KHz at a mere 0.1 per cent harmonic distortion.

The preamplifier is followed by switchable networks which remove the signals above 5KHz (high filter) and/or give a degree of loudness compensation. Following these networks is the tone control. The volume control for each channel consists of a pair of ganged potentiometers, one operating at the input of the tone control stage and the other at the output of the same stage. This ganged pair is ganged with the pair for the other channel. A similar arrangement is used on a number of Japanese amplifiers. It maintains an optimum signal-to-noise ratio over the whole control range and improves the overload capability of the tone control stage. At the output of the tone control stage is a low frequency filter.

The tone control stage consists of two NPN transistors in a Baxandall configuration giving a range of plus 12dB and minus 18dB at 30Hz and plus 8dB and minus 11dB at 15KHz. The high filter gives rapid rolloff at 18dB per octave above 5KHz and is certainly effective. By contrast, the low filter is a simple RC network and is not sharp enough to enable turntables with inherent rumble to be used satisfactorily.

Power amplifier circuits are in the familiar quasi - complementary configuration but the input stage is unusual in that it uses a low-noise NPN transistor in the "ground base" mode. Each power amplifier uses a total of seven transistors.





Above is the A.W.A. ST 953 tuner/amplifier which has a continuous power output of 30 watts per channel. At left is a view of the internal layout of the same unit. All the units in the A.W.A. range use basically the same layout which results in good accessibility. Note the compact transformer mounted well away from the amplifier circuitry.

MACRON ELECTRONICS PTY. LTD.

RECOMMENDS foster

SPEAKER ENCLOSURES

SPEAKERS

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MODEL No.	IMPEDANCE [Ω]	FREQ. RANGE [c/s]	INPUT [W]	SPEAKERS [mm]	DIMENSIONS [mm]
FCS-104	8	95~20,000	8	100(W), 85(T)	250H×158W×173D
FCS-200	8	60~20,000	40	200(W), 50(T)	530H×294W×240D
FCS-207	8	45~20,000	30	200(W), 50(T)	540H×295W×220D
FCS-208	8	70~20,000	30	200(W), 50(T)	480H×280W×200D
FCS-250	8	50~20,000	30	250(W), 80(T)	597H×321W×300D

COMPACT SPEAKER SYSTEMS

MODEL No.	IMPEDANCE [Ω]	FREQ. RANGE [c/s]	INPUT [W]	SPEAKER [mm]	DIMENSIONS [mm]
BF-103S	8	110~18,000	8	100(FULL-RANG)	320H×200W×174D
BF-163S	8	60~16,000	10	160(FULL-RANG)	384H×240W×174D
BF-203S	8	45~16,000	15	200(FULL-RANG)	477H×298W×254D

FULL-RANGE SPEAKERS

DIAMETER [mm]	DIAMETER [in.]	MODEL No.	V.C. IMP. [Ω]	RESONANT FREQ.(f_0) [c/s]	FREQ. RANGE [c/s]	SENSITIVITY [dB]	MAX. INPUT [W]
100	4	**FE-103**	8/16	65~ 95	f_0~18,000	96	10
160	6½	**FE-163**	8/16	40~ 60	f_0~20,000	98	10
200	8	**FE-203**	8/16	35~ 55	f_0~16,000	100	15
200	8	**FE-201**	8/16	60~ 90	f_0~16,000	100	8

WOOFERS

DIAMETER [mm]	DIAMETER [in.]	MODEL No.	V.C. IMP. [Ω]	RESONANT FREQ.(f_0) [c/s]	FREQ. RANGE [c/s]	SENSITIVITY [dB]	MAX. INPUT [W]
160	6½	**FW-162**	8/16	40~60	f_0~3,000	95	30
200	8	**FW-202**	8/16	25~35	f_0~2,000	97	45

W.A. D. K. Northover,
1 Dunvegan Road,
Applecross, 6153.
TAS.: Nichols Radio,
91 Wellington Street,
Launceston, 7250.

N.S.W.: Hartley Electromotive Pty. Ltd.,
181 High Street,
Willoughby. 2068.
VIC.: Macron Electronics,
70 Batesford Road,
Chadstone. 3148.

S.A.: Neil Muller,
8 Arthur Street,
Unley. 5061.
QLD.: T. H. Martin
56 Edward Street,
Brisbane. 4000.

Homecrafts TAS.
Astor House,
199 Collins Street,
Hobart. Tas., 7000.

The tuner section is one of the few commercial attempts at a high-quality wideband AM tuner. Using seven transistors in all, it appears to depend on overcoupled IF transformers for its wide bandwidth. Grounded base stages avoid detuning with AGC action. The tuner has a tuned RF stage and a separate oscillator.

Bandwidth with the tuner in the wideband mode is 8.7KHz (minus 3dB points) while in the narrow mode it is 3KHz. The AGC characteristic gives less than 6dB output variation for an input signal change from 10uV to 10mV.

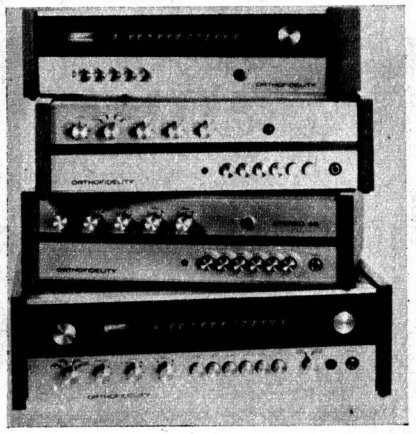
On test, the tuner/amplifier performed impeccably. AM reception was very good on local stations and it showed the high transmission quality of programs radiated by the Sydney radio stations, particularly the A.B.C. stations. With the aerial attenuator switched to "Distant" the tuner showed good sensitivity and selectivity. Even when receiving strong local stations in this mode cross modulation was not evident.

Using a high-quality magnetic cartridge and a pair of compact wide-range loudspeaker systems, the amplifier gave a very good account of itself on program material. There was a complete lack of background noise and all controls operated smoothly and noiselessly.

On test, the amplifier met or exceeded all figures in its specification except that for intermodulation distortion which we did not attempt to verify since it is so low—it is specified at less than 0.1 per cent at all power levels up to maximum. Continuous power output was 30 watts per channel with both channels driven simultaneously into 8-ohm loads. Harmonic distortion was less than 0.1 per cent but was difficult to measure due to a small amount of hum which was, however, not audible under normal listening conditions. Power output into 16-ohm loads was 20 watts continuous per channel with both channels driven simultaneously. At no power level did total harmonic distortion rise above 0.15 per cent and no crossover distortion was evident.

Frequency response was flat from 30Hz to 30KHz ±1dB. Power bandwidth was very wide — 20Hz to 100KHz at the minus 3dB points. Separation between channels was minus 55dB with respect to full power at 1KHz with the undriven channel input short circuited. These figures are very good and would do justice to amplifiers in any price range.

To sum up, its good to see local manufacturers turning out high-quality equipment at a price competitive with imported amplifiers of the same calibre. We hope that others follow suit. The retail price of the ST 953 is $349, including sales-tax.



Above are four of the units from the A.W.A. range. At top is the AM3 wideband tuner. Below that are the ST 45 and ST 95 amplifiers which are identical in appearance and at the bottom is the ST 953 tuner/amplifier.

Prices of the other units pictured are as follows: ST95 amplifier, $255; ST 45 amplifier, $229; AM3 tuner, $119. A.W.A. high fidelity equipment is available from retailers throughout Australia.

Trade inquiries should be addressed to the Consumer Products Division of Amalgamated Wireless (Australasia) Limited, Audio Sales Dept., 554 Parramatta Road, Ashfield, N.S.W. 2131. (L.D.S.)

EDGE CONNECTORS FROM McMURDO

From McMurdo (Australia) Pty. Ltd. comes a sample of their latest release of the locally made "Red Line" edge connectors. This connector differs from the other units in the range in that it is supplied in kit form permitting a wide variety of connector combinations to be assembled rapidly.

The basic mounting block of polypropylene has provision for up to 40 contacts although it may be quickly cut with a knife to provide shorter connectors as required.

The contacts are of gold-plated phosphor bronze. They are pushed into mounting slots in the poly moulding where they are securely locked by means of a special barb on each contact. Special mounting feet and polarising keys are available to suit individual requirements.

Three contact pitches are available, catering for the currently used PC board standard spacings, viz: 0.1", 0.15" and 0.156."

We had occasion to try the connector kit during construction of our recent amateur Handset and found it very simple to assemble, providing an excellent connector for the main circuit board. For those engaged in prototype development or experimental work we would recommend these connector kits for their flexibility.

Further information on technical specifications and price may be obtained from: McMurdo (Australia) Pty. Ltd., 242 Blaxland Rd, Ryde N.S.W. 2112. or 19 Carnish Rd, Oakleigh Sth., Vic. 3167 (A.D.N.).

A sample of the McMurdo "Red Line" edge connectors.

NEW ALL TRANSISTOR STEREO AMPLIFIERS WITH IN-BUILT A.M. TUNER

ULTIMATE IN DESIGN—LONG DEPENDABILITY

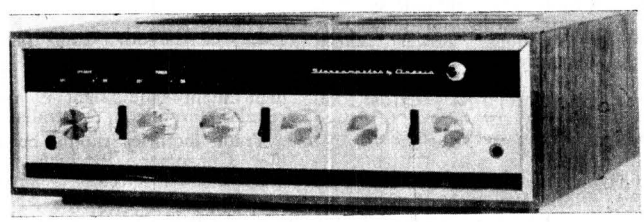
USING ALL SILICON TRANSISTORS

36 WATTS—RMS

SPECIFICATIONS:
18 watts per channel R.M.S. Total output 36 watts R.M.S.
FREQUENCY RESPONSE:
From 20 cycles to 20,000±1db.
HARMONIC DISTORTION:
Less than 1 per cent at rated output.
HUM AND NOISE:
Aux. 70db. Mag. 50db.
INPUT SENSITIVITY:
Mag. 3mv. Aux. 200mv.
SPEAKER IMPEDANCE:
8 ohms.
EQUALISED:
Mag. RIAA.
TONE CONTROLS:
Bass, 50 c/s ± 12db. Treble 10 kc/s 12db.
LOUDNESS CONTROL:
50 c/s 10db.
SCRATCH FILTER:
(High filter) at 10 kc/s 9db.
RUMBLE FILTER:
(Low filter) at 50 c/s 5db.
PROVISION FOR TAPE RECORDER:
Record or play-back with din plug connection.
PROVISION FOR HEAD PHONES:
With headphone/speaker switch on front panel.
DIMENSIONS:
16½in x 5½in x 11in deep.
TUNER:
This unit can be supplied with either valve or transistor tuner with a coverage of 530 to 1,600 K.C. Calibrated dial available for all States.
THE CIRCUIT INCORPORATES regulated power supply with transistor switching protection for output transistors. 26 silicon transistors plus 5 diodes are used.

MODEL C300/20/T

$125.00 PLUS FREIGHT
(CABINET EXTRA)



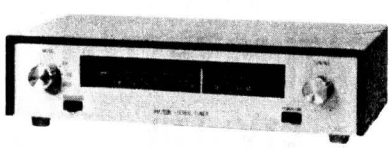
MODEL C400/20

$99.00
PLUS FREIGHT
(cabinet extra)

AMPLIFIER ONLY. Specifications as above but with the added feature of front panel switch which allows selection of two speaker systems.

CABINETS FOR ABOVE AMPLIFIERS IN OILED WALNUT OR TEAK WITH METAL TRIM $10.00 EXTRA.

NEW ALL-TRANSISTOR A.M. TUNER WITH PRE-AMPLIFIER



Suitable for use with all valve transistor Hi-Fi amplifiers, tape recorders or P.A. amplifiers.

SPECIFICATIONS

Frequency coverage 530 to 1600 K.C. bandwidth 9 K.C. Inbuilt aerial, provision for external aerial. 240 volt A.C. operation. Dimensions 10¾ x 6in x 3½in. Output variable from 50mv to 700mv.

$44.00 Post and Packing, N.S.W., $1.50.

CLEARANCE OF VALVE AMPLIFIERS WITH TUNERS BASED ON THE PLAYMASTER 106 AND 118 FROM $80.

POWER OUTPUT: 9 watts per channel R.M.S. FREQUENCY RESPONSE: 20 to 20,000 cycles incorporating Ferguson O.P.412 grain oriented output transformers. VALVES USED: 4-6GW8, 12AX7 or 12AU7, 6AN7, 6N8, EM84 and 2 silicon diodes.

CLASSIC RADIO

245 PARRAMATTA ROAD, HABERFIELD, N.S.W. PHONE 798-7145

NEW DANISH HI-FI SHOWROOM IN MELBOURNE

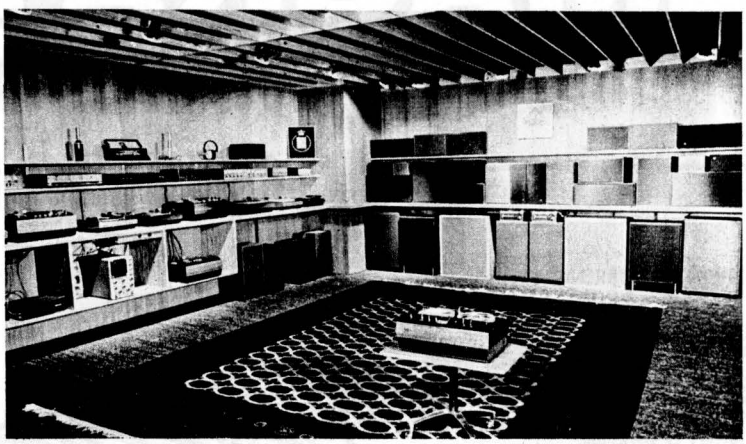
A new hi-fi showroom in Melbourne at the Southern Cross Hotel Shopping Plaza (Shop 9) has been designed to display and demonstrate high grade stereo equipment. The showroom is in a quiet section of the lower plaza, but close to Bourke Street and to the stairs from the carpark.

The proprietor, Danish Hi-Fi Pty. Ltd., has based the design upon the recommendation of the world famous Danish firm of Bang and Olufsen. This company not only manufactures attractive and technically near-perfect stereo equipment, but also sets up showrooms and stands in audio fairs in Europe in an outstanding and very distinctive style appropriate to the equipment.

Danish Hi-Fi, as the name implies, is endeavouring to promote stereo equipment of Danish design in Australia. The company claims that simplicity and good taste combined with a practical, functional concept bring great satisfaction to the user, apart from the pleasure which results from listening to good quality reproduction. Cabinets are styled in teak, palisander, or European oak with satin or brushed aluminium metal parts combined with matt black finish. Such styling is part of the modern Scandinavian scene and is growing in popularity in Australia.

It is easy to relax and listen carefully to music in such a quiet and restful showroom with conditions close to those in the home. Such careful attention is necessary when comparing two systems both approaching perfection in their quality of reproduction.

Danish Hi-Fi will specialise in high-grade stereo systems manufactured by Bang and Olufsen, but will also carry complete stocks of the full range of Dynaco amplifiers and other high-grade overseas equipment including Labcraft turntables, Hypertone loudspeaker modules from the U.K., Peerless loudspeakers, Pioneer, Philips, etc.



A section of the new Danish Hi-Fi sound studio at the lower plaza of the Southern Cross Hotel in Melbourne. The panelling of European oak is of particular interest, being protected by a clear lacquer as used in the Sydney Opera House and guaranteed to be free from yellowing for 99 years. The panelling is in keeping with the teak and palisander timbers of the Danish equipment cabinets.

System Draws Printed Circuit Artwork

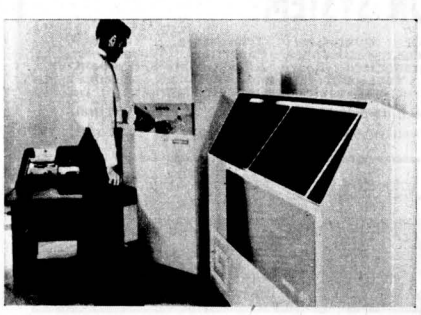
The Gerber System 40, a new low-cost contouring system designed to produce printed circuitboard artwork, is available in Australia from the electronics division of Distributors Corporation Pty. Ltd.

A feature of the system is the capability to produce complex printed circuit masks drawn 1:1 with no photographic reduction errors. The sharpness of line quality eliminates ragged edges and permits increased density of circuitry. System 40 includes a new table, contouring control and photohead, as well as a complete printed circuit artwork application program package, called Gerber Graphics Generator (3G).

The 3G software program provides the capability to convert geometric data from the drawings quickly and easily into a set of input cards. The cards are then read and automatically plotted by photographically exposing film or glass within a self-contained darkroom formed by the table's lightproof cabinet. This allows operation of the system in a normally lighted area.

The System 40 draws with accuracies of plus or minus .0015in and with repeatability of plus or minus .0005in. It has a maximum speed of more than 100in per minute over the 14in x 20in plotting area. The photohead, mounted on a beam over the plotting table, has 24 separate computer-selected apertures that may flash images or draw lines with sizes from .005in to 0.25in.

Further information is available from Distributors Corporation Pty. Ltd., 24 Johnston Street, Fitzroy, Vic. 3065.



MAGRATH'S

JULY MAIL ORDER SUGGESTIONS

PRECISION SOLDERING IRONS.

$4.15

The iron is available for 6-volt or 12-volt operation. The element is situated within the lower part of the shaft, enveloped by the skirt of the bit. This provides efficient heat transfer and thus obviates the need for excessive element temperatures. Reliability is insured by completely sealing the element to prevent oxidisation and by use of a special shock absorber which protects the element during everyday use in factory or workshop.

Replacement bits 55 cents each.
No. 2 3/32" No. 3 5/32".
No. 4 3/16".

SCOPE SOLDERING IRONS.

Scope de luxe. Complete with pouch pack, stainless barrel. Only 6 secs. initial heat-up time **$5.95**

Scope standard. 6 secs. initial heat-up. Performs work or irons requiring up to 150 watts **$5.50**

Miniscope Light. Only 5 secs. to initial heat-up time. Ideal for hard-to-reach spots **$5.28**

Vibroscope. Protects your property. Etch any metal ferrous or non-ferrous or annealed dull or polished Produces deep penetration . **$3.50**

Matching 3.3V transformer for these Scope products **$8.30**

COILMASTER

This hand-operated coil-winding machine will produce self-supporting universal and honeycomb coils. Also solenoid, single-layer etc. Three cams, 1/8in. 3/16in. and ¼in. throw are included with each. Using these in various combinations with four gears supplied and using different sizes of wire from No. 22 to No. 40 many types and sizes of coils can be made.

$15.95

HAND OPERATED NIBBLING TOOL.

"Adel" cuts round, square or irregular holes and shapes to any size over 7/16in and notches an dtrims undersized holes to fit points. Capacity-Steel to 18-gauge. Aluminium or Copper to 16-gauge. Punching Bakelite, Plastics, etc.

$5.95

Replacement Cutting Punch $3.75

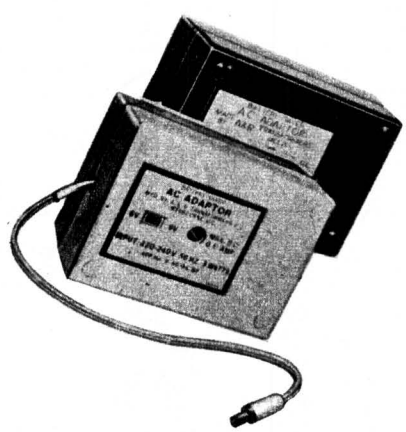
VEROBOARD.

Fully pierced copper clad
Copper clad each side
Veroboard Plain
Plug-in copper clad.
Vero-Edge Connectors
Terminal Pins
We have a full range of sizes in stock. Write for free descriptive leaflet and prices.

PIONEER SPEAKERS

This superb 15in unit is available with 8 ohm or 15 ohm Voice Coil. Power handling 30 watts R.M.S. 60 watts (peak). Freequency response to 500 cycles. Resonant frequency 60 plus or minus 12 cycles. Sensitivity 103 plus or minus 2 db/watt. Total flux 11,600 Maxwell Flux density 9.360 gauss.

$30



STENTORIAN SPEAKERS

MODEL HF1016.

10in P.M. Unit and 16,000 gauss magnet. Universal impedance speech coil at 3, 7.5 and 15 ohms. Capacity 10 watts. Frequency response 30 c.p.s. to 15,000 c.p.s. Bass resonance 35 c.p.s.

$21

MODEL HF 1012

10in Unit 12,000 gauss magnet. Universal impedance speech coil at 3, 7.5 and 15 ohms. Capacity 10 watts. Frequency response 30 c.p.s. to 14,000 c.p.s. Bass resonance 35 c.p.s.

$14

MODEL T. 10.

Speech coil impedance 15 ohms. Response 200/15,000 c.p.s. flux density. 14,000 gauss. Capacity: 5 watts

$16

CX 3000 CROSSOVER NETWORK.

W./B. Crossover is of the filter type and is fitted to all the Duplex Loudspeakers. It is available for use separately, the 3,000 c./s. type is half section series connected having an attenuation of 12dB per octave. CX 3000.

$6.50

T 359 TWEETER.

3,000 — 15,000 c.p.s Size overall 3½in diam. x 2in deep. Voice coil impedance 15 ohms **$6.50**

"RADAR" Regulated Battery Adaptor, $8.75
RADAR Solid State Inverter $26
RADAR 05X Power Supply Unit $15
RADAR Regulated Battery Eliminator Motor
MODEL 05XR ½ amp. input
MODEL 1XR 1 amp input $20.70

A & R BATTERY SAVER— A/C ADAPTORS.

PS 64 Specially for tape recorders 6 or 9 volt operation $14. PS 82. Specially for transister radios, 6 or 9 volt operation, $9. PS 104 Output voltage 4.5 volts, 6 volts, 7.5 volts, 9 volts and 12 olts DC Maximum current 0.5 amps, $21.45.

T. T. I. OSCILLOSCOPE.

Here's your opportunity to acquire a practical Oscilliscope at a truly unrepeatable price. Indented from a leading Japanese manufacturer, the T.T.I. CO-50 is an amazing versatile and compact Ocilloscope. It is an indispensable instrument to have in the Lab. or on the workbench. A compact portable 240V unit at this fantastic price. With vinyl carry case, $69.

KITSETS.

Magrath's have a full range of Electronics Australia Kits either for the beginner or the more experienced constructor. Write for detailed price list or Kit quoatation for any circuit of your choice.

'RADAR' CAPACITOR DISCHARGE IGNITION SYSTEM

- Easy starting in all weather.
- Improved miles per gallon.
- Point life up to 100,000 miles.
- Plug life up to 50,000 miles.
- No increase in drain from battery.
- Faster acceleration.
- Smoother running.
- Positive and negative earth.

FOR THE HOME CONSTRUCTOR

$29.50 When ordering specify Positive or negative earth.

Kit comprises: Transistors, Thyristor, Diodes, Resistances, Capacitors, Transformer, Printed Circuit Board. All assembly and mounting requirements and detailed assembly instructions, cables and circuit diagram.

Negative Earth CD1-NE for 12 volts system.

Positive Earth CE1-PE for 12 volts system.

ALL PRICES INCLUDE POSTAGE AND SALES TAX

J. H. MAGRATH & CO. PTY. LTD.
208 LT. LONSDALE STREET, MELBOURNE, VICTORIA, PHONE 663 3731

NEW PREMISES FOR RADIO PARTS PTY. LTD.

Radio Parts Pty. Ltd. has now completed extending and renovating its head office at 562 Spencer Street, West Melbourne. The company now has a total floor area of 39,000 sq. ft., including a general showroom (2,500 sq. ft.). a hi-fi showroom (1,200 sq. ft.) and a car park on the first floor and roof (10,000 sq. ft.) The old building was only 11,000 sq. ft. and had no provision for parking.

The hi-fi showroom (above) and the general showroom (left) in the enlarged premises of Radio Parts Pty. Ltd.

TRADE RELEASES—in brief

ROYSTON ELECTRONICS PTY. LTD., 22 Firth Street, Doncaster, Vic. 3108. Agents for Hughes Aircraft Co., U.S.A. **Dual complementary pair plus inverter, type LCOS 4007.** Hughes' first complementary metal oxide semiconductor (CMOS) integrated circuit, for circuit breadboarding and evaluation. Provides monolithic complementary N and P channel MOS transistors interconnected externally to produce large systems requiring very little supply power. Systems using this device can operate at frequencies in excess of 5MHz.

PLESSEY PACIFIC PTY. LTD. has announced the following appointments:

Mr R. K. Vinycomb as technical manager of Plessey Rola, Plessey Electronics and Plessey Dynamics, a new position created after the grouping together of these three companies. He is responsible for design and engineering concepts related to products within the three companies together with development in new product areas. Before joining Plessey, Mr Vinycomb was principal officer control systems engineering with the Weapons Research Establishment.

Mr Daniel D. Marantz to the newly created position of general production manager with the same three Plessey companies. His responsibilities include the manufacturing, industrial engineering and production control and purchasing functions. Mr Marantz previously held a manufacturing appointment with the Plessey Company in the U.K.

Mr J. A. Fyffe to the new position of secretary-controller of the three companies. Before his present appointment, Mr Fyffe had been secretary of Rola since November, 1968.

MOTOROLA SEMICONDUCTOR PRODUSTS, a division of Motorola Australia Pty. Ltd., 37-43 Alexander Street, Crow's Nest, N.S.W. 2065. **Negative voltage regulator, MC1563/1463.** These IC units have nearly identical specifications and performance as the MC1569/1469 positive voltage regulators. Features: continuous load currents up to 500mA; built-in electronic "shut-down"; short-circuit protection; temperature stability, typical, .0020pc/°C; low output impedance, 35 milliohms typical; high ripple rejection, typical, .003pc/V; MC1463 is in 9-pin TO-66 style case for operation from 0 to plus 75°C; MC1563 is full temperature version (minus 55 to plus 125°C).

IRH INDUSTRIES LTD., The Crescent, Kingsgrove, N.S.W. 2208, has announced the following appointments. Mr David Harris to the new position of executive assistant to Mr James Hatty, the general manager of IRH. In addition to an engineering background in electronics and automation, Mr Harris has had management consultancy experience during the past two years. Mr John Brewster to the newly created position of assistant manager of Natronics Pty. Ltd., the equipment division of IRH. Mr Brewster has had experience in the design and manufacture of defence-oriented and other electronic equipment in the U.K. and Australia. Mr Ross Smith as sales manager in Victoria for the equipment and components divisions, located at Fairfield in Melbourne.

PHILIPS INDUSTRIES LTD., 69-79 Clarence Street, Sydney, 2000. **Office computers, P350 series.** Provides the advantages of electronic data processing for those users and those tasks previously excluded from the use of computers on the grounds of capacity or cost. Features include: basic core memory of 200 words (1 word equals 15 positions and signs), and can be extended to 1,000 words; card punchers, card readers, tape perforators, and tape readers can be added; four peripheral equipments can work simultaneously with the basic machine; the P353

model processes magnetic accounts in addition; magnetic account cards have a capacity of 64 memory positions; equipped with high-speed printer capable of 50 spaces per second. The equipment will be marketed through Sydney Pincombe Pty. Ltd., in whom Philips recently acquired a majority interest.

JACOBY MITCHELL & CO. PTY. LTD., 469-475 Kent Street, Sydney, 2000. Distributors for Sony Corporation, Japan. **Integrated stereo amplifier, model TA-1010.** An all solid-state amplifier with a dynamic output of 58W. Features: harmonic distortion less than 0.5pc at rated output; signal/noise ratio better than 70dB, 3mV for PHONO-1 and PHONO-2 inputs, otherwise better than 90dB, 250mV; frequency response 20Hz to 60KHz plus 0 or minus 1dB for TUNER, AUX-1, AUX-2 and TAPE inputs, RIAA equalisation curve plus or minus 1 dB for PHONO-1 and PHONO-2 inputs; front panel controls — function selector, loudness switch, slide-variable balance control, high filter switch, main/remote loudspeaker switch, mode switch, treble and bass tone controls, tape/source monitor switch. List price is $189.95.

Compact 4-track, stereo tape recorder, model TC-252. Features: all silicon transistor ITL/OTL circuits; 4-track stereo/mono recording and playback system; retractable pinch roller for easy tape threading; operates in either vertical or horizontal position; sound-on-sound recording, either right channel on left or left on right; loudspeaker switch for on/off and monitor level control; public address facility; hi-fi lid-integrated satellite loudspeakers; 3 speeds; 7in reel capacity; dual VU meters; automatic shut-off switch; instant stop control; operates from either 50Hz or 60Hz supply with a frequency selector and a removable capstan sleeve; frequency response, 30Hz to 18KHz at 7½ips. List price is $279.

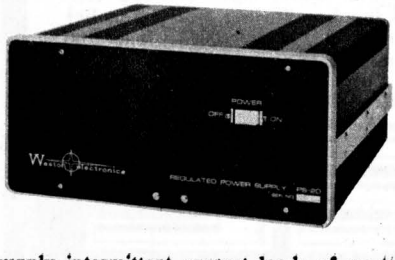
POLAROID AUSTRALIA PTY. LTD., 2-12 Smail Street, Ultimo, N.S.W. 2007. **CRT camera system.** A new system for producing instant, low-cost hard copies from CRT displays. It produces high-contrast, 3¼in x 4¼in black-and-white photographs in 15 seconds. The main components are the Polaroid CU-5 Land camera and a special, light tight plastic hood

that snaps on to the front of the camera to shield ambient light. The CU-5 camera is a lightweight, hand-held unit and features: pistol grip and trigger-like shutter release; simple exposure settings; no focusing rugged construction to withstand rigours of heavy industrial use; shutter mechanism is only moving part; non-electrical. In addition to its function as a shield, the hood also positions the camera at the correct distance from the screen.

INDUSTRIAL & DOMESTIC EQUIPMENT CO., P.O. Box 163, Dandenong, Vic. 3175. Agents for Delco Radio Division, U.S.A. **Silicon power transistors. Types DTS-401 and DTS-402,** for use in TV deflection circuits. The DTS-401 (vertical deflection) has good gain linearity, high collector-to-emitter voltage rating (400V), and operates from a 60V supply. The DTS-402 (horizontal) is used in large screen TV receivers requiring up to 2000VA while operating from a 60V supply. It features a 700V peak collector to emitter voltage, fast switching time, and high reliability under horizontal sweep fault condition.

Types DTS-701, DTS-702 and DTS-704, for use in TV deflection circuits operating off the line. The DTS-701 (vertical deflection) has a collector to emmitter voltage rating of 800V, while the DTS-702 and DTS-704 (both horizontal) have ratings of 1200V and 1400V respectively.

WESTON ELECTRONICS PTY. LTD., 376 Eastern Valley Way, Roseville, N.S.W. 2069. **Low voltage stabilised power supply, model PS20.** A low voltage, high current mains-operated DC power supply featuring very good regulation and low residual noise level. It is specifically designed to replace 12V secondary batteries where these are used to power electronic equipment. The PS20 is able to



supply intermittent current loads of up to 18A, which render it very suitable for the operation of AM and SSB transceivers. The unit is compact and well ventilated, and as an option may be used in conjunction with a 12V secondary battery to provide no-break operation, the battery being trickle charged from the PS20.

Low-priced Elliptical Stylus

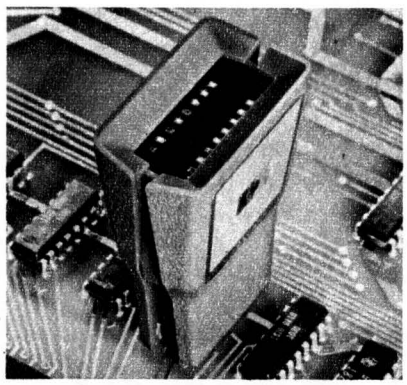
British Merchandising Pty. Ltd., who are Australian distributors for Decca audio products, have advised that an elliptical replacement stylus is now available for the well known Decca Deram cartridge. The stylus has tip radii of 0.0007in x 0.0003in, and is a direct replacement for the spherical stylus. The two styli will be distinguished by colour coding — yellow shank for the elliptical stylus, blue for the spherical.

Of particular interest to owners of Decca Deram cartridges will be the low retail price of $8 for the elliptical stylus. British Merchandising point out that difficulties have previously been experienced which prevented the mass production of elliptical styli. Now advanced technology and tooling have enabled Decca to offer the advantages of the elliptical stylus to users of the Deram cartridge.

Supplies are available through the normal trade and retail outlets. Further details can be obtained from British Merchandising Pty. Ltd., Box 3456, G.P.O., Sydney, 2001.

SIEMENS INDUSTRIES LTD., 544 Church Street, Richmond, Vic. 3121, has appointed Mr K. Schultz as manager, manufacturing development. Mr Schultz, who set up the first Siemens teleprinter production in Melbourne in 1960, will be responsible for investigation and introduction of the increasing local manufacturing activities of the company.

HEWLEY - PACKARD AUSTRALIA PTY. LTD., 22-26 Weir Street, Glen Iris, Vic. 3147. **Logic clip model 10528A.** A trouble-shooting and design aid that clips on to TTL or DTL integrated-circuit packages and instantly displays the logic states of all 14 or 16 pins. The clip has 16 light-emitting diodes, each of which follows voltage level changes on one pin; a lighted

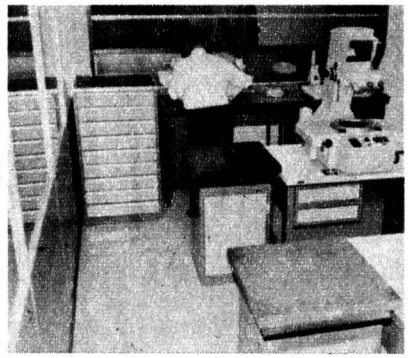


diode indicates a high logic state (plus 5V.). Features include: completely self-contained, requires no power connections or adjustments; draws its power from the circuit being tested; contains logic circuitry to locate the earth connection and plus 5V pins even if clipped on unsymmetrically; buffered inputs put no more than one TTL load on the circuit being tested.

AUSTRALIAN GENERAL ELECTRIC PTY. LTD., 103 York Street, Sydney, 2000. **Integrated voltage regulator (IVR), type D13V.** A monolithic integrated voltage regulator circuit in a standard epoxy TO-98 package. Designed for use as a shunt voltage regulating element, it can be used over wide voltage and current ranges. It also features a specified voltage temperature coefficient and can serve as an excellent reference amplifier for use in high precision, high power regulation systems. Ratings: total average power at 25 degrees C, 400mW; maximum regulated voltage 40V; maximum DC current 40mA; operating temperature range, minus 15 to plus 125 degrees C. Price 82c each in small quantities, available ex stock.

RUTHERFORD ELECTRONICS PTY. LTD., P.O. Box 30, North Balwyn, Vic. 3104. Agents for National Semiconductor Corporation, U.S.A. **Four-bit full adder, DM/7283/8283 (SN5483/7483.)** A complex TTL circuit adds two 4-bit numbers, accepting a carry at the input and propagating it to the output. The addition of each pair of bits occurs in parallel. Features: incorporates internal look-ahead circuitry to cut ripple time to 12nS; the equivalent of about 30 gates, it accepts four A and four B inputs plus the carry input, and has four sigma outputs plus the carry output; can also be used as a dual single-bit full adder; full temperature range version (minus 55 to plus 125 degrees C) comes in a hermetic dual-inline package; industrial version (0 to plus 70 degrees C) comes in a silicone DIP.

DUFF STEEL INDUSTRIES PTY. LTD., Flinders Street, Port Kembla, N.S.W. 2505. **Cabinets and benches.** For the storage of gauges, precision equipment and accessories in the modern laboratory. The system is modular for flexible planning and expansion. Construction is all steel for strength and rigidity. Bench tops



are usually covered with matt white Laminex for clean-room conditions. Stainless steel or other materials can be fitted instead. Drawers run on smooth-acting ball-bearing suspensions and are security lockable. All units are coated in heavy bodied synthetic enamel and oven baked to a durable gloss in attractive colours.

LANTHUR ELECTRONICS, 69 Buchanan Avenue, North Balwyn, Vic., 3104, is a newly formed company which is concentrating on building up kits for projects featured in "Electronics Australia." It has been formed by Mr A. Rosenthal, formerly with Warburton Franki Ltd. The telephone number is 85 4061.

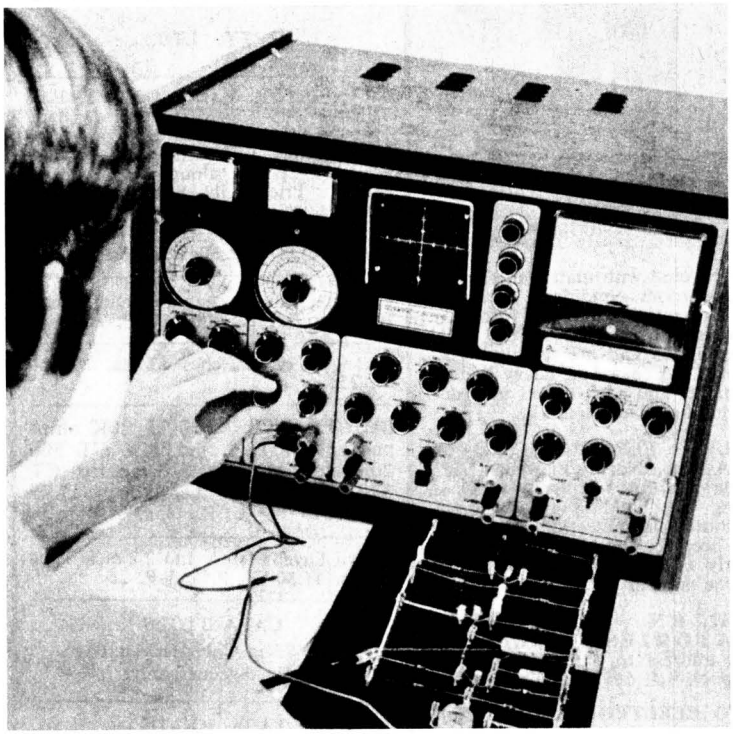
SOUTHERN ELECTRONICS LABORATORIES PTY. LTD. has changed its address to 14a Hanson Avenue, Heathpool, S.A. 5068.

TECNICO ELECTRONICS, a division of Pye Industries Ltd., has appointed Douglas Electronics Pty. Ltd. as Queensland distributor for Electrosil resistors. Douglas Electronics recently moved into new showroom premises at 322 Old Cleveland Road, Cooparoo, Qld.

TECNICO ELECTRONICS, a division of Pye Industries Ltd., 53 Carrington Road, Marrickville, N.S.W. 2204, has been appointed sole distributor for Rustrak Division of Gulton Industries Inc. of the U.S.A. Tecnico has for some time been co-agent for the Rustrak range of miniature recorders.

Rustrak 300 series two-wide strip chart recorder. Combines the capabilities of two or more standard line recorders on a common chassis with a single chart and common time basis. Models available include

event recorders with up to 16 channels; two channels of analog information and eight channels of on-off event data; four channels of analog information; or two analog and two event channels, among others. A full line of features can be incorporated such as two-point recording, chart and writing speeds suited to the parameter under study, or multiple temperature channels with actual or differential readings and gas or liquid pressure in many spans or offset ranges.



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E A

TECHNICAL BOOKS AND PUBLICATIONS

For DX enthusiasts

SHORT-WAVE VOICES OF THE WORLD, by Richard E. Wood. Published by Gilfer Associates, Park Ridge, New Jersey. Soft cover. 96 pages, 9in x 6in. U.S. price $3.95.

Richard E. Wood, of the University of Hawaii, is well known to medium-wave and short-wave listeners for his listening activities, and as a Professor of Languages has a wide knowledge in this field to add to his DXing ability.

This is a completely new type of publication for the radio listener. It covers the whole field of broadcasting from an historic point of view down to the short-wave listener's interest in reporting and verifying stations. It is well illustrated with photos of studios, transmitters, listeners and verifications of all kinds. The book covers in detail much of the background to present-day broadcasting, giving details of the political influence of international radio and even extends into the field of jamming. The book is divided into the following sections: Radio — The International Medium; Dividing Up the Radio Frequencies; Voices of the World; Languages and Station Identification; Broadcasting Around the World; Jamming — The Scourge of Broadcasting; Reception Verification and QSLs.

Further information on this publication can be obtained from Arthur Cushen, 212 Earn Street, Invercargill, New Zealand, who is handling stocks for listeners in this area. (A.C.)

Hi-Fi year book

HI FI YEAR BOOK 1970. Edited by Colin Sproxton. Published by IPC Electrical-Electronic Year Books Ltd., England. Hard covers, 8½ x 5¾in, 432 pages, numerous illustrations. Price in Australia $3.55, postage 50c.

Of the 432 pages which make this book, forty are devoted to the section of short articles which make up the first part. The rest is a directory of equipment available in Britain, with prices and names and addresses of suppliers. While many of the 2,000 pieces of equipment listed in the directory are available in Australia, a large percentage is not. The book therefore has only limited interest to the Australian high-fidelity enthusiast, although as a trade reference it could conceivably be regarded as a very useful publication.

In the articles section, the first item "Putting Separates Together" is a general discussion on the components of high fidelity systems, contributed by the well-known audio writer John Borwick. The numerous references to how much certain items should cost have little or no relevance here — in fact, it merely underlines the considerable disparity in ruling prices in the U.K. and Australia for the same items of equipment.

Other items are:

Speaker Enclosures, by R. C. Norris. This well written and informed discussion on the basic principles of the design of loudspeaker enclosures is one of the most useful items in the book.

Records — A Basic Collection, by W. A. Chislett. This contains the author's choice of classical records for a basic collection. Most (perhaps all) of the records are available in Australia.

The Care and Storage of Records by A. C. Williams. A short but useful item for those who are not familiar with the various factors which contribute to record wear and damage.

Tape Recorders and Recordings, by H. W. Hellyer. A potted history of tape recording and discussion of some features of modern recorders and tapes.

Stereo Radio — How it Works. Of academic interest only to Australian readers, but well written and illustrated with block diagrams.

Radio Tuners, by Gordon J. King. This tells what the purchaser of a radio tuner should look for in the U.K., where FM and stereo broadcasting are now firmly established as part of the entertainment scene. Of marginal interest only in Australia.

From the foregoing, it should be evident that the Australian buyer of this directory will obtain only limited benefit from it, particularly as there is virtually nothing new in the article section. It seems to this reviewer that the attractive cloth binding is a little extravagant for a year book, which has only limited life, and a paperback version at a more attractive price would be more practical for Australia. Our review copy was supplied by Technical Book and Magazine Co., 289-299 Swanston Street, Melbourne, Victoria, 3000, from whom copies are obtainable. (H.A.T.)

Tape recordings

DOCUMENTARY PROGRAMS ON TAPE, by Peter Bastin. Published by Tape Recording Magazine, London. Soft covers, 43 pages, size 7in x 4¾in. Price in Australia 90c post free.

The main thing about this series of handbooks for amateur tape recordists is that they are written by amateurs who have a wide and long experience in the very field in which they are writing, so they are essentially practical. The style might be laced with a heavy and facetious humour as in the text under review, but the author has been using tape recorders since 1953 and, in the process, has probably just about exhausted the possibilities of the hobby. So now he turns to writing about it for the benefit of his fellow hobbyists.

It is plain right at the start that the author is talking to amateurs on their own level. The first chapter is entitled "Setting Yourself Up," and he does not assume, as some authors tend to do, that everybody is loaded with money so that expense is no object. True, he emphasises the necessity for a good quality recorder, but where the studio is concerned, he mentions egg boxes as one means of killing unwanted echoes, as an alternative for polystyrene acoustic tiles. This chapter discusses the basis essentials for the recording studio.

Chaper 2, entitled "The Idea and the Script," covers very briefly the features of a good script, with the accent on brevity, sustained interest and continuity of thought. Background music and sound effects are also discussed.

Chapter 3, "The Job of Recording," is easily the longest chapter, and starts off with the very practical advice to see that the recorder is ready for use and in good condition before starting to

record. Presumably he has learned from experience and numerous spoiled tapes that this is not always the case. The rest of the chapter concerns recording and microphone technique. Finally, chapter 4, "And the Next Time," points out the need to learn from mistakes, by holding a "post mortem" on every tape.

Our review copy came from the Australian agent for Tape Recording Magazine publications, B. T. Lovett, 5 Glover Street, Willoughby, N.S.W. 2068, from whom copies may be obtained by post. (H.A.T.)

Pocket reference

ELECTRONIC VEST POCKET REFERENCE BOOK, by Harry Thomas. Published by Prentice Hall International, Englewood Cliffs, New Jersey, U.S.A. Hard covers, 210 pages, size 6 x 3in. Contains diagrams, tables, nomograms and charts.

Despite its small size and slim format, this little book has a wealth of useful information crammed within its pages. The title clearly explains its purpose — it is to carry around in your pocket and refer to as the need arises.

It has the following six sections:

Section A — Electronic Laws, Formulas. Data relating to Ohm's Law, resonance, reactance, dB calculations, semiconductor symbols and abbreviations, frequency bands, modulation, U.S. TV channels (the last being of no practical value in Australia).

Section B — Constants, Standards, Conversion. Includes such data as the SI system of units, English measure, electrical symbols and units, conversion factors and tables, electronics constants, multiples and submultiples, the periodic atomic table.

Section C — Symbols, Components, Codes. In addition to a large number of component symbols used in circuits, there is information on component marking and coding, a summary of resistor and capacitor types, and data on cables.

Section D — Mathematics, Mechanical Charts. In addition to the more common data found in this type of book (symbols, abbreviations, functions, tables of sines, cosines, tangents, logarithms, etc.) there are computer data (decimal-binary conversion, number codes), solution of triangle charts, fraction/decimal equivalents, Greek alphabet, thread, drill and tap sizes.

Section E — Circuits, Instruments, Measurements. This has circuits for DC and AC bridges, filters, rectifiers, valve and transistor type amplifiers, oscillators and other circuits, transistor test circuits, basic meter movements.

Section F — Microwave Hardware and Microelectronics. Includes MIL specifications for resistors, capacitors and cables, identification diagrams for types of screws, bolts, rivets, nuts and washers, wire tables, transducer types and characteristics, glossaries of microwave, computer and IC terms, display devices, SWR measurement set-up, thermistors (types, sizes, measuring circuits), and digital voltmeter characteristics.

The above listings are by no means comprehensive — there are far too many items included to list them all — but they do give an idea of the type of practical data to be found within the book. The user would need to be careful where conversions relate to American measure, but these occur in a few places only.

Our review copy came direct from the publishers, and no price information was given. (H.A.T.)

Wiring circuits

WIRING CIRCUITS, by C. H. Pike. Published by Butterworth & Co. (Publishers) Ltd., London, Third edition, 1970. Hard covers, 6 x 9in, 224 pages, many diagrams. Australian price $7.00.

As with earlier editions, this book is intended as a practical reference for the electrical engineer concerned with industrial rather than domestic wiring. The first two editions (published in 1951 and 1959) were prepared by the late Mr E. Molloy. This edition has been considerably revised by Mr Pike, who has written many books and articles on related topics since his first article was published in 1938.

In this third edition, most of the diagrams and supporting text are new, and the scope has been extended to take into account technical developments since the previous edition. It meets the requirements of the British Wiring Regulations including the latest amendments and metric supplement.

The circuits and supporting text aim to provide the electrical contractor, installation engineer and maintenance electrician, having only a basic theoretical knowledge, with the practical information necessary for them to carry out their work. Many diagrams give detailed circuits of various installations, while others are block diagrams to show the basic interconnections between units of complex installations. In addition, there are diagrams illustrating the principles of operation or the internal connections of equipment units.

The ten chapters of the book are as follows: 1 — Distribution Systems (high and low voltage, 3-phase and single-phase); 2 — Protective Schemes (excess-current, earth-fault and circulatory current protection and discriminative tripping); 3 — Special-Purpose Supplies (voltage-regulated AC and DC supplies, rectifier equipments, thyristor control, and low-voltage supplies for portable tools); 4 — Lighting Circuits (including starter circuits for fluorescent lighting, cold cathode lighting, and time switches); 5 — Heating Control Circuits (thermostats, off-peak storage heating, central heating systems); 6 — Indicator, Alarm and Clock Circuits (including bell and indicator systems, fire and burglar alarms, and electric clocks); 7 — AC Motors and Control Gear (starting circuits, sequence control, intrinsically-safe control circuits, variable-speed and change-speed control); 8 — DC Motor Control (starting circuits, braking methods, speed control schemes, thyratron, ignitron and solid-state equipments); 9 — Cranes and Lifts; 10 — Welding Circuits (arc and resistance welding).

While generally meeting its stated aim, the value of this work is limited in Australia and New Zealand by the need to read it in conjunction with the wiring regulations of these countries, which differ somewhat from the British

Look at the screen not at the knobs

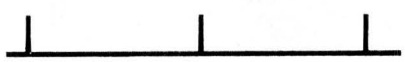
With Philips Fully-automatic Triggering

PM 3200
10MHz
2mV/div
$318.00
plus tax if applicable.

With this 'scope operators spend more time measuring, less time knob twiddling. Because three tricky controls are eliminated.

Dc balance. Trigger stability and manual level. So triggering is fully automatic.

Explanation. When waveforms start looking like this



all other automatic trigger circuits stop triggering. So you have to switch to manual and start knob twiddling.

With the Philips PM 3200 you switch from 'mean' to 'top' and stay with signal-derived, fully-automatic triggering.

In either position automatic means automatic over the whole 10 MHz range. And then on to at least twice this figure.

This unique Philips circuit has yet another feature. Whatever the signal, even no signal and whatever the sweep speed, the trace is always clearly visible.

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The PM 3200 is highly portable (12 lbs). And mains-independent if you use the optional battery pack.

Conclusion. Fully-automatic triggering. No drift. Less controls. Better operator usage.

For more information contact:
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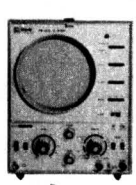
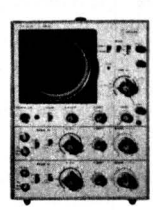
69 Clarence St., Sydney, N.S.W. 2000.
Or your nearest Philips Office.

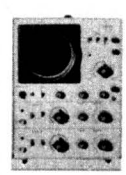
More of the Unbeatable Philips 0-15 MHz Range



PM 3221
10MHz:10mV
Delay Line
$491.00
(Duty Paid)



PM 3230
10MHz:20mV
Two-gun, twin beam
$654.00
(Duty Paid)



PM 3231
15MHz:10mV
Two-gun, delay lines
$898.00
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standards. With this proviso, the book should nevertheless provide a useful work of reference to the electrical contractor, industrial engineer or others in this field.

Our review copy was supplied by Butterworth & Co. (Australia) Ltd., 20 Loftus Street, Sydney, 2000. Copies should be available from all leading booksellers. (J.H.)

Semiconductors

SEMICONDUCTORS FROM A TO Z, by Phillip Dahlen. Published by Tab Books, Blue Ridge Summit, Penn., U.S.A., 1969. Soft covers, 5½in x 8½in, 272pp., many photographs and diagrams. Australian price $6.15.

This book was reviewed in our March, 1970, issue on page 141. Briefly our reviewer considered that while the book is up-to-date and covers the operation of modern semiconductors from the practical point of view, it does not concern itself overmuch with the basic theory of these devices. Its main value, therefore, would appear to be to the reader seeking a more cursory knowledge of semiconductors.

We have been informed that copies of this book are now available from Angus and Robertson Ltd., 89 Castlereagh Street, 2000.

LITERATURE—in brief

THE MOON AS VIEWED BY LUNAR ORBITER, by L. K. Kosofsky of NASA and Farouk El-Baz of Bellcomm Inc. Published by the National Aeronautics and Space Administration, 152 pages, price $US7.75. Orders to Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, U.S.A. Photographs chosen from the 3,100 taken on five Orbiter missions preparatory to the Apollo flights provide nearly complete coverage of the lunar surface. Index maps indicate the area shown in each view. In addition to conventional photographs, the book contains four full-page stereoscopic pictures showing Aristarchus, Schroter's Valley, Rimae Parry, and the Tobias Mayer Dome. Special spectacles are provided with the book.

STANDARDS ASSOCIATION OF AUSTRALIA, 80 Arthur Street, North Sydney, N.S.W. 2060, has published the following standards, copies of which may be obtained from the various offices of the association at the prices quoted.

AS C186, approval and test specification for polytetrafluoroethylene (PTFE) insulated flexible cords. It is one of the series of approval and test specifications issued under Part II of the SAA Wiring Rules. AS C186 relates to flexible cords insulated with PTFE, or PTFE and glass fibre, and intended for use at a maximum operating temperature of 200 degrees C in electrical installations at working voltages not exceeding 250V to earth of 400V between phases. Price 60c.

AS C330, pressure sensitive adhesive electrical tapes. It is a revised standard intended to provide a uniform basis, in terms of performance requirements, for the purchase of pressure sensitive adhesive tapes to be used in electrical applications, and to establish standard test methods for such tapes. It applies to tapes to be used for holding, binding, and insulating in electrical applications. C330 includes as an annexure, draft IEC methods for the determination of electrolytic corrosion, including dielectric breakdown. Other tests are prescribed by reference to AS Z24. Price $1.60.

AS C410, circuit-breakers for distribution circuits of rated voltage up to and including 1000V AC and 1200V DC (current ratings 63A and above). Based on British Standards and IEC documents, amended to suit Australian conditions. It covers in detail the characteristics of circuit-breakers with either air or oil as the interrupting medium. With the publication of the standard AS C89 (oil circuit-breakers for AC systems) and AS C380 (heavy-duty air-break circuit-breakers for AC systems) no longer apply for circuit-breakers having rated voltages below 1000V AC. Price $2.40.

MOTOROLA SEMICONDUCTOR PRODUCTS, a division of Motorola Australia Pty. Ltd., 37-43 Alexander Street, Crow's Nest, N.S.W. 2065, has available a TTL Interchangeability Guide which gives a complete cross reference to the company's total TTL capability. Currently the MC3000 and the MC7400 series are stocked in Australia.

EMERSON AND CUMING INC., Canton, Mass. 02021, U.S.A., has published an illustrated chart in colour describing all of the standard plastic and ceramic foams offered by the company. Basic materials include polyurethanes, epoxies, phenolics, silicone rubbers, glasses, silica, and other ceramics. Properties listed include bulk density, cell structure, maximum service temperature, colour, compressive strength, thermal conductivity, water absorption, dielectric constant, and loss tangent. Many applications are listed and illustrated including electronic packaging, heat and vibration insulation, lightweight machined parts, and lightweight lenses and aerials for microwaves.

TELECOMMUNICATION JOURNAL, Vol. 37, No. 4, April, 1970. Published by the International Telecommunication Union (ITU), Place des Nations, 1211 Geneve 20, Switzerland. Contents: Multi-condition codes and message transmission with automatic error detection or error correction, and their use in circuits without a return channel, by L. Caceres Garcia; Long-distance interrogation of ocean data stations moored in the North Pacific ocean, by R. F. Devereux; Spectrum management and non-broadcast requirements in the United States, by R. P. Gifford.

Under the heading of "Ideas and Achievements," reports are published on: Telecommunications in Sweden, a general survey; Spacecraft to test ion rocket engine (SERT-2). The section on "Union Activities" includes an illustrated report on the ITU Seminar on Space Communications, and reports on the meetings of CCITT working Parties II/2 (Revision of the instructions for the international telephone service) and XIII/1 (Switching and signalling maintenance and service quality assessment on the international automatic telephone network). A table of artificial satellites launched between January 1 and December 31, 1969 is included in a 14-page supplement.

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Price: $35.00
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The model HT-70 is a transistor Tester employing a 50uA high sensitivity meter. Ico & β measurements are indicated directly on the meter.

Ranges: Ico: 0-900 uA α: 0.90-0.99 β: 0-200

Features:

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The model HT-70 Transistor Tester is backed by "University" sales, spare parts and service.

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Telephones: 53 0644 (5 lines).
Telegrams and Cables: Raquip, Sydney.
Victorian Office.
Contact Mr Graeme Wright on 397 7253 or at 8 Langridge St., Werribee.

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S.A.: Compar Distributors Pty. Ltd. 33 Market Street. PORT KEMBLA DISTRICT
And now also at Port Kembla, N.S.W. Hundell Engineering Sales Pty. Ltd., 1 Fitzwilliam St., Port Kembla 2505. 43 397.
QLD.: Keith Percy & Co. Pty Ltd., Waterloo Street. NEWSTEAD: Brisb., Qld. 4006.
N.Z.: Allum Electrical Co. Ltd., 21 Liverpool Street, AUCKLAND, N.Z.
NEWCASTLE DISTRICT: Hunter Engineering Sales Pty. Ltd., Cnr. Gordon Ave. and Parry Street, Hamilton. NEWCASTLE, N.S.W. 2303. Phone 61-4321

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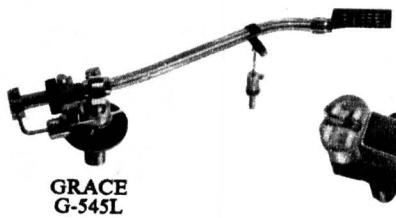

GRACE

Here it is! Grace, the brand with the sensational reputation for top performance at remarkably inexpensive prices. At the top you see the G-545L super lightweight pick-up arm. It tracks down to just 0.25 gm. and features a gimbal-type bearing system. The ultra-lightweight head shell and the new arm shape reduce tracking error to a virtually negligible factor. Extremely precise balancing is allowed for in the divided counter balance weight. Sub weight adjustments allow stylus pressures from 0 to 3.0 gm. If you wish, there is the G520L arm that features all the best qualities with only some minor differences in specifications. Ask for a demonstration, or copies of the authoritative, independent reviews on Grace stereo cartridges. Encel recommend Grace stereo cartridges for professionals and amateurs. The F-8L for instance, is of such high compliance and tracking lightness that it is ideal for use in testing of audio equipment. Complete distortion-free performance; stabilised; fully corrected; easy to change. See also the F-8C and F-8M.

SONICS

They come in all price ranges, but here is the one top of the Sonics range . . . AS-330. This 3-way system features 5 speakers, 12" woofer, a pair of 6½" mid-range speakers and two exponential tweeters. Frequency response 30-20,000 Hz, with smooth sound provided for by the carefully selected crossover frequencies. Hand finished in teak/walnut and most attractive; incorporating a fret grill 15⅜" x 26" x 11⅝". Also from Sonics—Speakers AS-303 and Stereo Headphones.

ENCEL

ELECTRONICS PTY. LTD.

Head Office: 431 Bridge Rd., Richmond, Victoria. 3121. Tel. 42 3762.
Sydney Store: Ground Floor, 2SM Building, 257 Clarence Street, Sydney, N.S.W. 2000. Tel. 29 4563, 29 4564.
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MOBILE COMMUNICATIONS, P.O. Box 105, Clayton, Vic. 3168, has published a 50-page illustrated pocket-size handbook for electronic engineers and purchasing officers. It is written in three sections: quartz crystals; packaged selectivity; and oscillators. It gives information on general technology, a table of crystal types with frequency ranges, letter code specification, a table of equivalent crystal holders, frequency/temperature performance curves, types of crystal units, crystal filter types, and military specifications.

HEWLETT-PACKARD JOURNAL, Vol. 21, No 8, April, 1970. Published by the Hewlett-Packard Co., U.S.A. Inquiries to Hewlett-Packard Australia Pty. Ltd., 22-26 Weir St., Glen Iris, Vic. 3146. Contents: Timer/Counter/DVM: A Synergistic Prodigy—introducing a new universal counter with in-built integrating digital voltmeter; Measuring Nanosecond Time Intervals by Averaging; High Accuracy AC Calibration to 1100V; A New Camera for High-Speed Oscilloscope Recording.

HY-Q ELECTRONICS PTY. LTD., P.O. Box 256, Frankston, Vic. 3199, has published its quartz crystal product line and price schedule for 1970. This lists the types of holder, crystal cut, frequency range and basic price. Special and urgent deliveries can be offered at quoted surcharges. In addition to the basic range, crystals are available for other temperature ranges, tolerances and circuit conditions, each at a quoted surcharge. The list also gives the minimum equivalent parallel resistance limits and maximum series resistance limits to meet defence and military specifications.

PLESSEY ROLA PTY. LTD., Magnetic Materials Unit, Browns Road, Noble Park, Vic. 3174, has published a booklet which deals with the manufacture, properties and applications of the ferro-ceramic materials known as Caslox produced in several isotropic and anisotropic grades. Caslox components are made from iron oxide, barium carbonate, and strontium carbonate by a compacting and sintering process. These materials are characterised by their ability to withstand strong adverse magnetic fields and varying temperature conditions without permanent loss of magnetisation.

SENNHEISER MICRO-REVUE 69/70. Published by Sennheiser Electronic, West Germany. Available for $1, post free, from the Australian agent R. H. Cunningham Pty. Ltd. G.P.O. Box 4533, Melbourne, 3001, or branch offices. Contents: Interesting facts about microphones (eight pages explaining technical terms encountered in microphone specifications); Dynamic microphones; Transistorised condenser microphones Dynamic stereo headphones; Magnetic earphone capsules; Hi-fi stereo reproducer HS 303 "Philharmonic"; Radio microphone system "Mikroport" SM 1008; Transformers; Studio equipment; Audio test equipment.

CORNING GLASS WORKS, P.O. Box 38, Liverpool, N.S.W. 2170, has available an application note MAN-6 published by the Electronics Products Division of the parent company in the U.S.A. The illustrated note describes the use of glass digital memory modules in high-speed buffers for computer terminals and other data transmission systems. It shows how glass memories designed into buffer applications combine the benefits of low cost and high speed. Diagrams illustrate the memory functions in a variety of systems. Steps in considering and selecting memory configurations are discussed with the objective of using as few modules as possible.

INVENTUS, Vol. 6, Issue 10, April, 1970. The Journal of the Inventors' Association of Australia Ltd., Box 3400, G.P.O., Sydney, 2001. Contents: New members including the first overseas associate member; Head office and branch reports; Brussels 19th International Inventions Exhibition; The Tern-side story; Prince Philip Prize for Australian Design, 1970; Inventions available for licence or sale; Technical news; The role of the industrial designer in the seventies; New corporation to protect Australian interests; A world first for Brisbane factory; Swedes hail C.S.I.R.O. man's atomic work.

TECHNICALITIES. Published by Tecnico Electronics, P.O. Box 12, Marrickville, N.S.W. 2204. Contents: Lower Electrosil prices; Electrosil IC Pick-a-Back connector and laboratory resistor kit; Corning NA and NC resistors; Signetics DCL integrated circuits; Rustrak agency; Bourns potentiometers; Pye Industries aluminium bus-bars; Bell power system transducers; Yaskawa electric motors; Bell magnetic field monitor; Rustrak Thermist-O-Meter with recorder output; Rustrak recorders and recorder chart paper; P.C.D. digital data readers; Pacific Measurements frequency synthesiser and other instruments; Princeton low noise pre-amplifier, vibrating sample magnetometer, and lock-in amplifier.

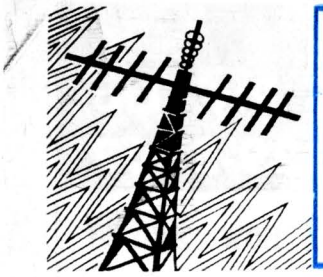
VARIAN PTY. LTD., 38 Oxley Street, Crow's Nest, N.S.W. 2065, has available the following publications of Varian Associates, U.S.A. Application engineering bulletin AEB-103 discusses a new method for measuring the thermal impedance of IMPATT diodes. The method uses the reverse-bias characteristics of the current-voltage curve of the diode. A 12-page catalogue published by the Analytical Instrument Division describes the firm's line of NMR, EPR, and mass spectrometers, laboratory electromagnets, data processing systems, and geophysical instruments.

ECCOSYN SYNTACTIC PLASTICS. Published by Emerson and Cuming, Inc., Canton, Mass. 02021, U.S.A. An illustrated folder describes the company's range of Eccosyn foams which consist of hollow microspheres of glass, ceramic or plastic bonded into a plastic matrix. The

folder discusses various applications and lists the properties and data for each type of Eccosyn foam.

TELECOMMUNICATION JOURNAL, Vol. 37, No. 5, May, 1970. Published by the International Telecommunication Union, Place des Nations, 1211 Geneve 20, Switzerland. Contents include: The role of small earth stations in civil communications satellite systems, by J. L. Blonstein; Improved version of the McNish-Lincoln method for prediction of solar activity, by F. G. Stewart and S. M. Ostrow; Estimate of the telephone demand in Venezuela, by the Compania Anonima Nacional de Telefonos de Venezuela.

Under the heading of "Ideas and Achievements," reports are published on: The ground control system of Azur; 40 years of German shortwave broadcasting; A new integrated circuit which is simple, inexpensive and easy to build. The section on "Union Activities" includes reports on: the XIIth Plenary Assembly of the International Radio Consultative Committee (CCIR) held in Delhi from January 21 to February 11; The Secretary-General's visit to India and Nepal; and the meeting of CCITT Working Party II/1 on international accounting methods.



AMATEUR BAND NEWS AND NOTES

Intruders in the amateur service bands

Transmissions from commercial stations causing interference to amateur service communication are being scrutinised by many amateur radio operators.

by Pierce Healy, VK2APQ

Shortly after the International Telecommunication Union Conference held at Geneva in 1959, an intruder watch organisation was formed by the Radio Society of Great Britain and the American Radio Relay League. In recent years the Wireless Institute of Australia has also established a similar group among its members.

The purpose of these intruder watch groups is to identify the offending stations, and report to a central point within the society instances of harmful interference to transmissions from amateur stations operating within the specified amateur service frequency allocations.

The growth of these organisations has been slow, but a gradual increase in this activity among the members of some of the larger amateur societies has seen some practical results. It has been reported that several stations that were persistent offenders have moved out of the 7.0MHz, 14MHz and 21MHz amateur bands. Some of the stations were Radio Pakistan, Radio Cairo, ULV Moscow and EPD Teheran.

It should be noted that not all harmful interference on exclusive amateur frequency allocations is caused through stations actually operating within the band, but could be caused through harmonic or spurious radiation being transmitted by broadcast stations.

To assist in identifying the various types of signals that may be causing harmful interference, the British Post Office has prepared a tape recording, with explanatory commentary, demonstrating 28 types of emission.

A copy of the tape has been circulated to all W.I.A. Intruder Watch co-ordinators in each State. Further copies can be made available to any amateur operators who would like to assist in identification of offending stations.

Any amateur operator prepared to join an Intruder Watch group should write to the INTRUDER Watch Co-ordinator, Wireless Institute of Australia, in the State in which he resides. Full postal addresses appeared in last month's notes.

CHRISTMAS ISLAND

Probably the most isolated radio club in the world is that operating on Christmas Island, in the Indian Ocean. Despite this fact, the enthusiasm of the island's amateur operators has resulted in the Christmas Island Radio Club becoming known throughout the world of amateur radio.

A story which could be called the "Saga of the Christmas Island Radio" has been received from Don Reed, VK9DR, who, back in 1931, operated under the call sign VK2DR. Don's story makes interesting reading and may be an inspiration to others:

"You may or may not have your own amateur radio station but whether you have or not, one of the greatest joys of amateur radio is to belong to a local club.

"The local club gives us the opportunity to get together for an eyeball QSO, gives the newcomer a chance to get started, enables organised field days, barbecues and hidden transmitter hunts to be held, to stimulate local interest in amateur radio. The club also brings the wives and friends together where they can enjoy some outside company and a good grumble about the shortcomings of the OM. Your local amateur radio club needs your membership. If you have not joined a club then you are missing a lot of fun.

"Let's take a look at the Christmas Island Radio Club. Take a tropical island having 54 square miles of jungle, gridded with mining roads, with the Indian Ocean rolling to its shores, which rise to a plateau 1,000ft above sea level. Take a bunch of enthusiasts, amateurs and would-be amateurs who put their cotton-pickin' fingers on a disused galvanised iron shed and erected it plumb centre on that 1,000ft plateau.

"A group who gained sufficient support from their mining employers (British Phosphate Commissioners) to have electric light and power supplied from a nearby spur line, or from an emergency plant. Who scrounged a surplus refrigerator, some shelving and a big lockup cabinet for the amateur radio gear.

"Who laid a concrete floor and talked a sympathetic wife into parting with some Hong Kong floor matting and who found piping and scrap copper wire and bamboo rods for making masts and aerials and then set up a home constructed AM/CW transmitter and an old disposal AMR type receiver and got going on the air.

"That was the start of VK9XI back in 1963.

"Let's have a look at VK9XI today. With a membership of 33, including Malays, Chinese, Indians, Eurasians and Europeans. Club premises have been expanded to three rooms, one for operating, one for members' rag chewing and thirst quenching, the third for Youth Radio Club meetings, workshop, store, lecture room and for dual operating.

"What have we achieved?

"The original licensed amateur membership of two, Mat Mathew, VK9MV and Don Reed, VK9DR, got Bob, VR1L, now on Ocean Island, started when he was at Christmas Island. Alan, VK9MD, now in VK3, got the bug and took out his amateur licence. Then came Alan, VK9ZAW, now in VK6; and Ron Ashley, VK9RA, our current president. Early training was given to three Asian commercial operators employed at the Christmas Island communication station. At the present time several members are on the verge of obtaining their licences.

"Christmas Island has been very active in DX operation. Logs covering over 30,000 contacts have gone through our QSL managers, VK6RU and W2GHK.

"We have five-band high-frequency operation on single-sideband, AM and CW. Shortly a 146MHz beacon transmitter will be installed on a 200ft tower. Transmitting members have operated mobile while on vacation from the island from many parts of Australia. We have participated in major contests and have set up portable stations for participation in the John Moyle Memorial Field Day Contests.

"VK9XI is also active in two WICEN emergency networks and with the co-operation of the commercial station operators, provide an official monitoring service for Radio Australia transmissions to South-East Asia.

"We have had many hidden transmitter hunts with all island participation. 7MHz is used so that transistor radios may be used. Members take delight in having barbecue picnics with wives, families and friends in attendance.

"Our Youth Club started off with 16 members, mainly Asian Scouts and Guides, who enjoyed participating in the Jamboree-of-the-Air. The Youth Club is affiliated with the Western Australian Division and club members are encouraged to learn to operate the equipment under supervision and to increase their knowledge of radio and electronics, which will assist them in future careers.

"The population of Christmas Island is 3,500 (approximately 2,000 Chinese, 1,000 Malays, 150 Indians and 350 Europeans). Club membership stands at 33 but we are not satisfied with that.

"What is the population of your town? Can you help your local club by bringing in more members. Back your local club and earn yourself a mighty good time."

SEANET

In his letter accompanying the story on the Christmas Island Amateur Radio Club, Don Reed, VK9DR, the club's publicity officer, commented that there are not many VK stations calling in on the very popular South East Asia Net which is used by Christmas Island amateurs. Details of the net are:

Frequency: 14320KHz.

Time: 1200GMT Daily.

Net Controller: 4S7PB (Paddy Gunasekera).

Duration of the Net: Usually 20 to 30 minutes.

VK stations are called in order of prefix rotation. Why not join the net and meet the Christmas Island boys?

A NEW CERTIFICATE

The Dutch Society, Vereninging van Radio Zend Amateurs, has issued a new certificate for working all Dutch Provinces (WAP).

The certificate is available to those who supply proof of two-way contact with one

News and notes of Divisional and Club activities submitted for inclusion in these columns should be forwarded direct to Pierce Healy, 69 Taylor St., Bankstown, N.S.W. 2200.

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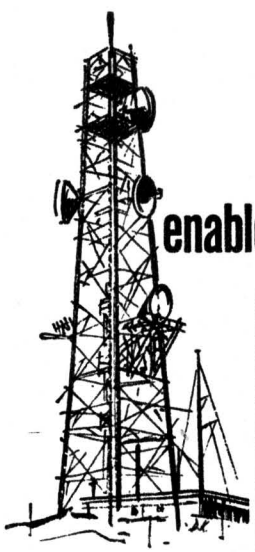

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amateur station in each of the following Dutch Provinces; or the proof of reception by a shortwave listener.

Groningen (GR), Friesland (FR), Drente (DR), Overijsel (OV), Gelderland (GD), Utrecht (UT), Noord Holland (NH) Zuid Holland (ZH), Zeeland (ZL), Noord Brabant (NB), Limberg (LB).

An amateur station in the "Noord Oost Polder" (NOP) may substitute for any other province.

Other certificates issued by V.R.Z.A. are: Dutch DX Certificate, DXCC. This is available upon proof of two-way communication, any mode, with 25 Dutch amateur radio stations, two of which must be located in the Netherlands Antilles and Surinam.

VHF — 50: This award is available upon proof being given of two-way communication, any mode, with 25 amateur radio stations of a distance of at least 250 miles (400KM) and 25 amateur radio stations over a distance of at least 25 miles (40KM) on the 144MHz band.

Short wave listeners may also gain these awards by supplying proof of reception of the same number of stations.

Applications should be sent to "Certificate Manager V.R.Z.A". P.O. Box 190, Groningen, The Netherlands. Enclose a list of confirmed stations, stating date, time, frequency and mode. This list should also be signed by two licensed amateurs or one member of the Certificate Hunters' Club.

For each certificate, 10 IRC's must be enclosed to cover handling costs.

YUGOSLAV ANNIVERSARY

To celebrate the occasion of their National Anniversary, "25 years of liberation of Yugoslavia," Yugoslav radio amateurs are allowed to use the prefix "YT" during the period from January 1 till to December 31, 1970.

The secretary of the national amateur radio society — SRJ — Aleksandar Jablanovic, YU1AY extends his best wishes to all amateur radio operators.

W.I.A. ACTIVITIES

The Captain James Cook Bi-Centenary Award is proving to be a very popular award. At any time on the DX bands comments may be heard regarding the interest in Australia it has caused. A sidelight is that there have been quite a number of private contests instituted among some of the ardent overseas DX operators who vie with each other to see who can work the necessary 50 "AX" calls in the shortest period. An unconfirmed report is that a "W" operator claims to have achieved the quota in a period of one hour before breakfast.

NEW SOUTH WALES

The A.O.C.P. Class manager Cec Bardwell, VK2IR, has indicated that there are a few vacancies in the lecture course that commenced the second term last month. This provides an opportunity for anyone who wants to do a revision course for the A.O.C.P. examination in January 1971.

Inquiries may be made by telephone to the Wireless Institute Centre, 14 Atchison Street, Crow's Nest; phone 43 5795. Details of the correspondence course may also be obtained from the same address.

Central Coast Branch: Members of the Central Coast Branch of the N.S.W. Division have decided that now the new club room has been completed, meetings will be held twice monthly. A general business meeting will be held on the first Friday of each month and a lecture and discussion meeting on the third Friday of the month.

It is thought that keeping one night free from business discussions will make meetings more streamlined and interesting to the younger members of the club.

At a recent meeting a most interesting lecture was given by Dick VK2BBK. The subject was "Earthing and Safety of Portable Electric Tools."

Congratulations are extended to club member Mona Swinton, VK2AXS, who recently gained her pilot's licence. Mona is the wife of Alex, VK2AAK and is probably the only Australian aviatrix who is also an amateur radio operator.

The club rooms are located at Kariong at the Woy Woy turnoff from the Pacific Highway, just south of Gosford. Visitors are welcome.

VICTORIA

Geelong Amateur Radio-Television Club: Since the last appearance of notes from the Geelong Amateur Radio-Television Club, considerable progress has been made and members have benefited from the facilities now available.

At the annual general meeting for 1970, Mike Trickett, VK3ASQ was elected president. Other office-bearers elected were:

Vice-president: Terry Leith, VK3ZXY.

Secretary: Bob Wookey, VK3IC.

Treasurer: Terry Mitchell, VK3ZZQ.

Technical Officer: Darly St. John, VK3AQR.

Public Relations: Hayden Chittock, VK3ZLA/T.

Property Officer: Andrew Bindemanis, VK3ZXN.

The membership this year at present totals 58, made up of 41 seniors and 17 juniors. Of these, 13 hold the A.O.C.P. licence and 14 the L.A.O.C.P. licence.

The major project undertaken during the past year was the construction of a new meeting room in East Geelong. The successful completion of the project was due to the enthusiasm and generosity of the members. This achievement was made possible through the many generous donations from patrons and the fund-raising efforts during the previous year. The meeting room was built from the ground to lock-up stage in eight weeks.

During the coming year the club will undertake stage two of the building program. This will treble the amount of space now available. The additions will include two operating studios, library, workshop, second meeting room and an amateur television studio. Work on the second phase was due to commence at the beginning of June.

Recognising the importance of encouraging the youth of Geelong to develop an interest in amateur radio, classes have been conducted dealing with basic electricity and radio theory, supplemented by the screening of appropriate films.

One of the interesting lectures given recently was on the subject of medical electronics. The lecturer was Ray Cowling, VK3ZUG. Several different types of heart pacemakers were displayed and the lecture was illustrated by the use of models and diagrams.

Plans are being made to start an amateur television section. The first project will be a 432MHz FET converter suitable for the reception of amateur television transmissions. A club television transmitter will be then constructed by members.

The popularity of FM mobile operation among Geelong amateurs has increased with the erection of a 144MHz repeater. This facility was made possible by an independent group of amateurs in the area who provided the funds and time for the construction and installation of the equipment, which operates on channel 4.

All FM operation is now carried out on channel 4 with channel B (146MHz) used as a secondary or backup channel. Channel A (145.854MHz) is no longer used in the Geelong area.

As a part of its services, the club will make available test equipment and technicians to keep all the FM car units in peak performance condition. Also, suggestions to improve the equipment will be disseminated. This service is available to all amateurs in the Geelong area, whether they are club members or not.

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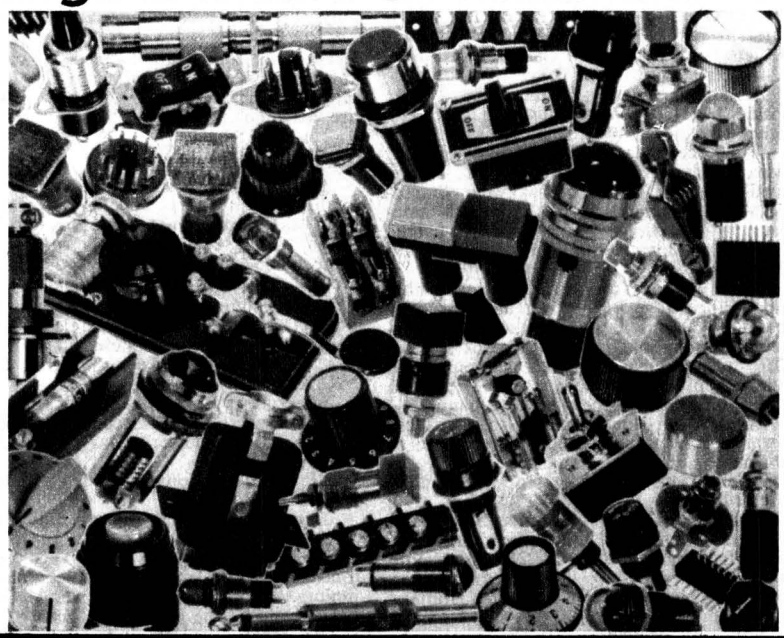

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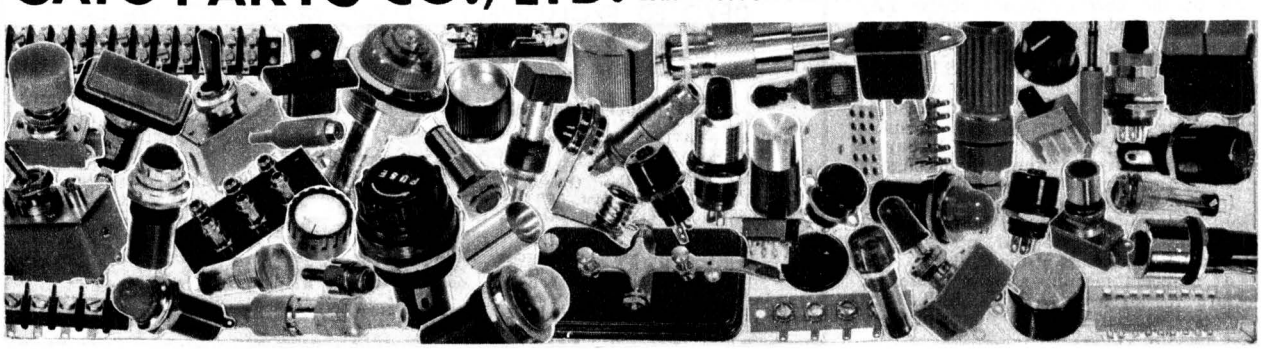

Many social events are enjoyed by members; for example, barbecues, picnics and dinner dances are conducted throughout the year. Regular features at the club are technical lectures, demonstrations, technical films and visits to communications installations.

Meetings are held every Friday evening at 8 p.m. and an invitation is extended to visitors and intending members. Details of all activities may be obtained by writing to — The Secretary, Geelong Amateur Radio-Television Club, Box 520, P.O., Geelong, Victoria, 3220. Information can also be obtained by telephoning 21 2674 (Geelong).

Eastern and Mountain District Radio Club: Some notes on the activities of the Eastern and Mountain District Radio Club have come to hand. The office bearers for 1970 are:

President: Ken Nesbet, VK3AKK.
Vice-president: John Boyce, VK3AXF.
Secretary: Keith Nicholls, VK3ANI.
Treasurer: Keith Purchase, VK3YCQ.
Committee: Tony King, VK3IO. Bob Collander, VK3AQ, Les Jenkins, VK3ZBJ.

This year, the club has a post office box and telephone facilities available for the benefit of members and interstate visitors who may wish to contact the club. The postal address is P.O. Box 87, Mitcham, Victoria, 3132. And the Melbourne telephone number is 874 1709.

Membership of the club is open to anyone in the world. It is not necessary to be a licensed amateur operator, just to have an interest in some form of radio communication. Subscription fees are 50c joining fee, and an annual subscription of $2. Application for membership should be sent to the treasurer at the above address. Membership automatically entitles you to a year's subscription to the club's publication "The Radio Bulletin."

The club recently made a donation of $200 towards the construction and testing of the second Australis Oscar satellite project. It is hoped that this action will set an examply to other clubs who may wish to support this worthy project.

Plans are in hand for an organised tour of the Radio Australia installation at Shepparton where members will be able to see very high-powered equipment in operation.

Consideration is also being given to conducting instructional courses for those wishing to obtain the Amateur Operator's Certificate of Proficiency. Anyone interested in such a course is invited to write to the Publicity Officer at the address given above, or ring the telephone number given.

The club meets on the last Friday in each month at the Mooroolbark Technical School, Raey Road, Mooroolbark. All visitors are welcome; no prior notice is necessary, just follow the ring road to the rear of the school to find the entrance to the club.

Australian Postal Institute Radio Club: An intensive rebuilding program and the renovating of the club room and equipment has somewhat restricted the on-air activity of the Australian Postal Institute Radio Club station VK3API. However, with the work nearing completion VK3API is well on the way to becoming a showpiece.

Membership of the club is restricted to members of the Australian Postal Institute but visits to the club may be arranged by first ringing the club's Publicity Officer, Tony King, VK3IO, telephone 20 2411 (Melbourne) during business hours.

So far this year, 45 members of the club have sat for and passed the Youth Radio Scheme Elementary Certificate course and it is expected that many of them will sit for the A.O.C.P. examination by the end of the year.

On completion of the work on the station facilities, operation will be possible on all amateur bands from 160 metres to 2 metres. On working days, transmitting sessions are planned between the hours 1215 to 1315EST. The club will send a QSL card for contacts made on any band by the next mail service and included with the card will be a brief history of the club.

Office bearers for 1970 are:

President: Bob Whalley, VK3ZWZ.
Secretary: Ian Macdonald, VK3AXH.
Treasurer: Dave Hunt, VK3YBG.
Publicity Officer: Tony King, VK3IO.
QSL Manager: Theo Van Stavern VK3AMA.
Safety Officer: Bob Reid, VK3ZZR.
Projects Officer: Dave Buck, VK3AAD.
Publications Manager: Dave Moore.

SOUTH AUSTRALIA

The office-bearers of the South Australian Division council for 1970 are:

President: John Allen, VK5UL
Immediate Vice-president: Tom Laidler, VK5TL
Vice-presidents: Roger Pullem VK5ZKK; Geoff Taylor, VK5TY
Secretary: Ross Dow, VK5KF
Treasurer: Harry Roberts, VK5MY
Publications Officer: Neil White, VK5WN
Journal Editor: Alan Isaachsen, VK5ZEI
VK5WI Operator: Colin Luke, VK5XY
Associates representative to council: Tom Hannaford, ——
Minute Secretary: Roger Pullem, VK5ZKK
Program Organiser: Neil White, VK5WN
Y.R.C.S. Liaison Officer: John Allen, VK5UL
VHF Group Representative: Allan Isaachsen, VK5ZEI
Federal Councillor: Geoff Taylor, VK5TY

There has not been any change in other positions, i.e. QSL Manager, WICEN Co-ordinator, etc.

WESTERN AUSTRALIA

The report from the retiring president of the Western Australian Division, given at the Annual General Meeting held in April, indicated that the division had made steady progress during the previous 12 months. However, a steady increase in the enrolment of new members during the year had offset the losses due to transfers to other States, etc. Attendances at meetings had been good and the WICEN organisation had progressed to a point where a workable net was available, should it be required.

On this note it was pleasing to see that three members of the WICEN net provided emergency communication services between Pinjarra and Perth at the request of the authorities, following a mishap when a bulldozer cut the co-axial cable linking Perth with the south-west of the State.

It was also stated that the financial affairs of the division were in a satisfactory state, but in view of increased commitments it would be necessary to increase fees during this financial year.

At the annual meeting, Jack Park, VK6BB, was elected to Honorary Life Membership of the division. Jack has been a member of the division since 1921. He was divisional secretary from 1924 to 1926 and a member of council until 1940. He is still an active member of the division.

The following members were elected unopposed to the council for 1970-1971:

R. Elms, VK6BE
N. Penfold, VK6ZDK.
G. Byass, VK6ZDB
K. Khuen-Kryk, VK6IZ
D. Priestley, VK6ID

YOUTH RADIO CLUB SCHEME

At the Annual General meeting of the New South Wales Division Y.R.C.S. the following office bearers were elected:

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Metal Glaze is the result of IRC materials research involving glass technology and metallurgy. It incorporates the principal advantages of other classes of resistive materials ... economy of carbon composition, stability of wire-wound, and the precision of evaporated metal film.

IRC Metal Glaze is a thick film of metal alloys fused to a crystalline ceramic substrate. It is up to 100 times thicker than conventional films and occupies the dimensional middle ground between metal thin films and bulk composition units.

Mechanically, Metal Glaze is extremely hard and rugged. It is impervious to environmental extremes such as moisture, temperature, shock, vibration and is resistant to chemical attack.

Electrically, this new resistance material is inherently stable. It provides very good temperature coefficients across a wide resistance range.

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18002/2

State Supervisor: Dave Jeans, VK2BSJ.

Executive Committee: Secretary-Treasurer: Jack Flynn; Registrar for N.S.W.: Don Craig.

Management Committee: Doug Williamson, VK2ZDZ, Millar High School; Roberto Girdo, VK2ASD, Birrong Radio Club. Peter Vernon, VK2BPV, Marcellan College Radio Club. Jim Webster, VK2ZJW, Birrong Boys' High School. Jefi Post, VK2BGP.

On Sunday May 24, 60 members of various Y.R.C.S. clubs in Sydney met at Wireless Institute Centre and were taken by bus to the division's transmitting station at Dural. All told more than 100 attended the first Y.R.C.S. Field Day organised by N.S.W. management committee. The day proved to be very successful. Many events were conducted during the day including the popular hidden transmitter hunts. A meeting was also held of the club organisers in attendance.

Some of the day's activities were filmed by Sydney's Channel 10 television station and included in their news magazine session on Sunday evening, May 31.

Westlakes Radio Club: Many members of the Westlakes Radio Club reported very strong signals received from the experimental earth satellite launched recently by the People's Republic of China. The satellite, transmitting on a frequency of 20.009MHz, was first reported copied at 11.16 p.m. EST Monday, April 27 and again at 11.02 p.m. EST Tuesday, April 28. Since that time many passes have been tracked. A tape recording of the signals made by David Russell, VK2BSC was subsequently played at a recent Hunter Branch meeting.

The signals from the satellite contained telemetry information and the Radio Peking identification tuning signal "The East is Red."

The following signals were repeated each minute:

00-20 seconds	The East is Red
20-40 seocnds	The East is Red
40-45 seconds	Carrier
45-57 seconds	Telemetry—21 voice-frequency tones
57-60 seconds	Carrier

Following the adoption of a policy of encouraging adult A.O.C.P. class members to attempt the various Youth Radio Club Scheme certificate awards, four club members were successful in the Elementary Certificate examination. They were:

Wal Lean, Honours
John Dove, Credit
Norman Judd, Credit
Eric Brockbank, Pass

An excellent newsletter is published by the club each month. Each issue contains, in addition to news of the club's activities and its members, several technical articles and projects of special interest to members.

The leading article in the May issue was a thought-provoking treatise on the value of constructing various pieces of equipment needed in pursuing the hobby of amateur radio. The emphasis placed on this aspect at the club is aptly expressed in the last paragraph of the article:

"The club is continually striving to help boys to **understand** radio. It is not just enough to join wire A to point X, pull down switch Z and hope for the best. In recent weeks, members of the Junior Class have been making printed circuits. They began not knowing what etched what and who did all the printing. Now most of them know at least two processes for making printed wiring boards and they are beginning to design their own projects. Perhaps that wise Chinaman who said 'I hear and I forget; I see and I remember; I do and I understand,' had something after all, so what price construction?"

Maitland Amateur Radio Club: From June 1, 1970, radio amateur operators throughout the world will be eligible to qualify for the Maitland City Award. To gain the award overseas stations must establish two-way radio contact with two member stations of the Maitland Amateur Radio Club. Australian amateurs will qualify for the award by making two-way radio contact with three member stations of the club plus one contact with the official club station, VK2BHV on the high frequency bands; or VHF operators may contact either of the club's official stations VK2ZVM and VK2BHV.

When applying for the award, overseas applicants should send a certified extract from their log accompanied by two IRCs. Australian applicants are required to send 10c with a certified extract from their log.

All applications should be sent to:

Secretary,
Maitland Amateur Radio Club,
P.O. Box 54,
East Maitland, N.S.W. 2323,
Australia.

Club members journeyed from Maitland to attend the first Youth Radio Club Scheme Field Day held at the N.S.W. Division's transmitting station at Dural. The club was represented among the prize winners by John Gibson who won a Hidden Transmitter Hunt using his home-made "Sniffer."

Members of the Saturday Elementary Certificate Morse code class are preparing for their first test at five words per minute. Those attending the Junior and Elementary Certificate course are busy preparing for their imminent exam.

Approval has been given by the Maitland City Council for additions to the present building, to be used as a store-room. This will be the club's next project and will make available space for extra class room facilities.

Amateur television experiments being carried out under the supervision of Des Mills are progressing very satisfactorily and a start is being made to add sound to the experiments.

The club publishes a very informative magazine, known as the "Maitland Radio Club News." It appears on the 1st of each month and is available at $1 per year in Australia or $2 per year for overseas subscribers. Subscriptions should be sent in advance to the publishers, M.R.C. News, Box 54, P.O. East Mailatnd, N.S.W. 2323, Australia.

Further details of the club's activities can be obtained by writing to the Secretary P.O. Box 54, East Maitland 2323. Or Maitland, telephone 33 7286.

SOUTH AUSTRALIA

The Y.M.C.A. Electronics Club has what must be a record number of members for a youth radio club in South Australia. Present membership now stands at 80, and includes those up to 20 years of age. It is understood that facilities were not available to cater for some over the age of 20 years who applied for membership.

Two new clubs to register with the scheme are:

Unley High School Youth Radio Club; Mitchell Park Boys' Technical High School Electronics Club.

At Unley, Mr W. F. Smith is the club leader and instructor. Mr Smith is on the teaching staff of the school. Other office bearers are:

President: Keith Briggs.
Secretary: Lee Phillips.
Treasurer: Geoff Stranks.
Committee Members: Peter Torward, Kym Wood, Dino Dabillo, R. Hill.

The club has 22 members.

At Mitchell Park a member of the teaching staff, Mr A. R. Tuck, is the club leader. He is assisted by Mr P. C. Bachli, teacher of applied electricity at the school, and J. Machell as junior assistant club leader.

The club has 18 members and meetings are held on Friday each week at 2.30 p.m. Mitchell Park was the third club to register in South Australia, but has been inactive for the last three years.

(Y.R.C.S. Notes cont. on page 171)

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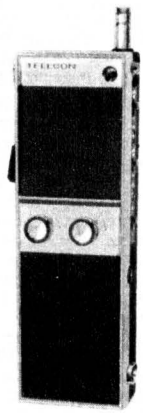

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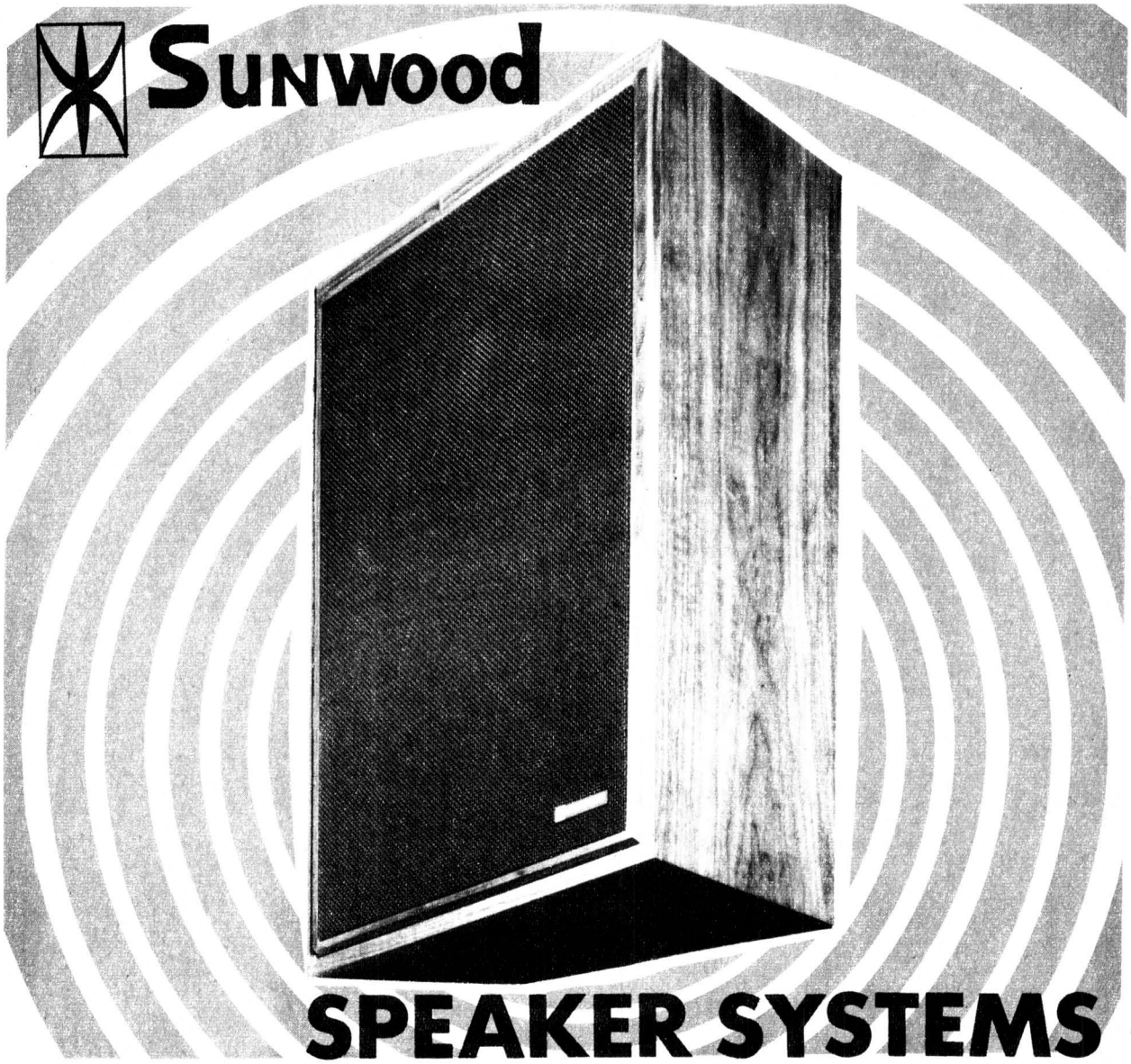
MI-70

AUSTRALIAN D.X.C.C. COUNTRIES LIST

The current alphabetical list of prefixes as at March, 1970, issued by the W.I.A. for the purpose of DX Awards.

Prefix	Country
A2, ZS9	Botswana
AC1, 2, 5-0	Bhutan
AC3	Sikkim
AC4	Tibet
AP	East Pakistan
AP	West Pakistan
BV	Taiwan
BY	China
C2, VK9	Nauru
C3, PX	Andorra
CE	Chile
CE9AA-AM, FB8Y, KC4AA-US, LA, LU-Z, OR4, UA1, VK0, AX0, VP8, ZL5, ZM5, 8J	Antarctica
CE0A	Easter Is.
CE0X	San Felix
CE0Z	Juan Fernandez
CM, CO	Cuba
CN2, 8, 9	Morocco
CP	Bolivia
CR3, 5	Portuguese Guinea
CR4	Cape Verde Is.
CR5	Principe, Sao Thome
CR6	Angola
CR7	Mozambique
CR8, 10	Portuguese Timor
CR9	Macao
CT1	Portugal
CT2	Azores
CT3	Madeira Is.
CX	Uruguay
DJ, DK, DL, DM	Germany
DU, DX	Philippine Is.
EA	Spain
EA6	Balearic Is.
EA8	Canary Is.
EA9	Rio de Oro
EA9	Spanish Morocco
EA0	Spanish Guinea
EI	Republic of Ireland
EL, 5L	Liberia
EP	Iran
ET3, 9E, 9F	Ethiopia
F	France
FB8W	Crozot Is.
FB8X	Kerguelen Is.
FB8Z	Amsterdam and St. Paul Is.
FC	Corsica
FG7	Guadeloupe
FH3, FB3	Comoro Is.
FK8	New Caledonia
FL8	French Somaliland
FM7	Martinique
FO8	Clipperton Is.
FO8	French Oceania
FO8M	Maria Theresa
FP8	St. Pierre and Miquelon
FR7 (from 25/6/60)	Glorioso Is.
FR7 (from 25/6/60)	Juan de Nova
FR7	Reunion Is.
FR7	Tromelin
FS7	Saint Martin
FW8	Wallis and Futuna Is.
FY7	French Guiana and Inini
G, GB	England
GC	Guernsey and Dependencies
GC	Jersey Is.
GD	Isle of Man
GI	Northern Ireland
GM	Scotland
GW	Wales
HA, HG	Hungary
HB	Switzerland
HB0, HE	Liechtenstein
HC	Ecuador
HC8	Galapagos Is.
HH	Haiti
HI	Dominican Republic
HK	Columbia
HK0	Bajo Nuevo
HK0	Malpelo Is.
HK0	San Andres and Providencia
HL, HM	Korea
HP	Panama
HR, HQ	Honduras
HS	Thailand
HV	Vatican
HZ, 7Z	Saudi Arabia
I, IR, IT	Italy
IS1	Sardinia
JA, JH, JR, KA	Japan
JD1, KA1, KG6I	Bonin and Volcano Is.
JD1, KA1, KG6I	Marcus Is.
JT	Mongolia
JW, LA/P	Svalbard
JX, LA/P	Jan Mayen
JY	Jordan
K, KN, W, WA, WB, WC, WN	U.S.A.
KB6	Baker, Howland and American Phoenix Is.
KC4	Navassa Is.
KC6	Eastern Caroline Is.
KC6	Western Caroline Is.
KG4	Guantanomo Bay
KG6	Guam
KG6R, S, T	Mariana Is.
KH6, WH6	Hawaiian Is.
KH6	Kure Is.
KJ6	Johnston Is.
KL7, WL7	Alaska
KM6	Midway Is.
KP4, WP4	Puerto Rico
KP6	Palmyra Group, Jarvis Is.
KR6, 8	Ryuku Is.
KS4	Swan Is.
KS4B, HK0	Serrana Bank and Roncador Cay
KS6	American Samoa
KV4, WV4	Virgin Is.
KW6	Wake Is.
KX6	Marshall Is.
KZ5	Canal Zone
LA, LJ	Norway
LU	Argentina
LX	Luxembourg
LZ	Bulgaria
MP4B	Bahrein
MP4D, T	Trucial Oman
MP4M, VS9O	Sultanate of Muscat and Oman
MP4Q	Qatar
OA	Peru
OD5	Lebanon
OE	Austria
OH, OF	Finland
OH0	Aland Is.
OJ0	Market Reef
OK, OL, OM	Czechoslovakia
ON	Belgium
OX, KG1, XP	Greenland
OY	Faroe Is.
OZ	Denmark
PA, PE, PI	Netherlands
PJ	Netherlands Antilles
PJ	Sint Maarten
PY, PQ, PR, PS, PT, PU	Brazil
PY0	Fernando de Noronha
PY0	St. Peter and St. Paul's Rocks
PY0	Trinidade & Martim Vaz Is.
PZ1	Surinam
SK, SL, SM	Sweden
SP, 3Z	Poland
ST2	Sudan
SU	Egypt
SV	Crete
SV	Dodecanese
SV	Greece
TA	Turkey
TF	Iceland
TG	Guatemala
TI	Costa Rica
TI9	Cocos Is.
TJ, FE8	Cameroun
TL (from 13/8/60)	Central African Republic
TN (from 15/8/60)	Congo Republic
TR (from 17/8/60)	Gabon Republic
TT (from 11/8/60)	Chad Republic
TU (from 7/8/60)	Ivory Coast
TY (from 1/8/60)	Dahomey Republic
TZ (from 20/6/60)	Mali Republic
UA, UV, UW1-6, UN1	European U.S.S.R.
UA, UV, UW9, 0, UZ0	Asiatic U.S.S.R.
UA1	Franz Josef Land
UA2	Kaliningradsk
UB5, UT5, UY5	Ukraine
UC2	White Russian S.S.R.
UD6	Azerbaijan
UF6	Georgia
UG6	Armenia
UH8	Turkoman
UI8	Uzbek
UJ8	Tadzhik
UL7	Kazakh
UM8	Kirghiz
UO5	Moldavia
UP2	Lithuania
UQ2	Latvia
UR2	Estonia
VE, VO, 3B, 3C	Canada
VK, AX	Australia
VK2, AX2	Lord Howe Is.
VK4, AX4	Willis Is.
VK9, AX9, ZC3	Christmas Is.
VK9, AX9	Cocos Is.
VK9, AX9	Norfolk Is.
VK9, AX9	Papua Territory
VK9, AX9	Territory of New Guinea
VK0, AX0	Heard Is.
VK0, AX0	Macquarie Is.
VP1	British Honduras
VP2A	Antigua, Barbuda
VP2D	Dominica
VP2E	Anguilla
VP2G	Grenada and Dependencies
VP2K	St. Kitts, Nevis
VP2L	St. Lucia
VP2M	Montserrat
VP2S	St. Vincent & Dependencies
VP2V	British Virgin Is.
VP5	Turks and Caicos Is.
VP7	Bahama Is.
VP8	Falkland Is.
VP8, LU-Z	South Georgia Is.
VP8, LU-Z	South Orkney Is.
VP8, LU-Z	South Sandwich Is.
VP8, LU-Z, CE9AN-AZ	South Shetland Is.
VP9	Bermuda Is.
VQ1	Zanzibar
VQ9	Aldabra
VQ9	Chagos Is.
VQ9	Desroches
VQ9	Farquahar
VQ9	Seychelles
VR1	British Phoenix Is.
VR1	Gilbert, Ellice and Ocean Is.
VR2	Fiji Is.
VR3	Fanning and Christmas Is.
VR4	Solomon Is.
VR5	Tonga Is.
VR6	Pitcairn Is.
VS5	Brunei
VS6	Hong Kong
VS9A, P, S	Aden and Socotra
VS9K	Kamaran Is.
VU	India
VU4	Laccadive Is.
VU5	Andaman and Nicobar Is.
XE, XF, 4A	Mexico
XF4	Revilla Gigedo
XT (from 6/8/60)	Voltaic Republic
XU	Cambodia
XW8	Laos
XZ2	Burma
YA	Afghanistan
YB, YC, YD, PK, 8F (from 1/5/63)	Indonesia
YI	Iraq
YJ, FU8	New Hebrides
YK	Syria
YN, YN0	Nicaragua
YO	Romania
YS, HU	Salvador
YU, YT	Yugoslavia
YV,4M	Venezuela
YV0	Aves Is.
ZA	Albania
ZB2	Gilbraltar
ZD3	The Gambia
ZD5, ZS7	Swaziland
ZD7	St. Helena
ZD8	Ascension Is.
ZD9	Tristan da Cunha & Gough Is.
ZE	Rhodesia
ZF1, VP5	Cayman Is.
ZK1	Cook Is.
ZK1	Manahiki Is.
ZK2	Niue
ZL, ZM	New Zealand
ZL, ZM/A	Auckland and Campbell Is.
ZL, ZM/C	Chatham Is.
ZL, ZM/K	Kermadec Is

Sunwood



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153 Sturt Street, South Melbourne.
Cnr. Ingham Rd. & Echlin St., Townsville.
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Prefix	Country
ZM7	Tokelaus
ZP	Paraguay
ZS1, 2, 4, 5, 6	South Africa
ZS2	Prince Edward & Marion Is.
ZS3	South West Africa
1M	Minerva Reefs
1S	Spratly Is.
3A	Monaco
3B6, 3B7, VQ8	Agalega and St. Brandon
3B8, VQ8	Mauritius
3B9, VQ8	Rodriquez
3V8	Tunisia
3W8, XV5	Vietnam
3X, 7G	Republic of Guinea
3Y, LA/G	Bouvet Is.
4S7	Ceylon
4U	I.T.U., Geneva
4W	Yemen
4X, 4Z	Israel
5A	Libya
5B4, ZC4	Cyprus
5H3, VQ3	Tanzania
5N2, ZD2	Nigeria
5R8, FB8	Malagasy Republic
5T (from 20/6/60)	Mauritania
5U7 (from 3/8/60)	Niger Republic
5V	Togo Republic
5W1, ZM6	Samoa
5X5, VQ5	Uganda
5Z4, VQ4	Kenya
6O1, 2, 6	Somali Republic
6W8, FF8 (from 20/6/60)	Senegal Republic
6Y5, VP5	Jamaica
7P8, ZS8	Lesotho
7Q7, ZD6	Malawi
7X, FA	Algeria
8P, VP6	Barbados
8Q, VS9M	Maldive Is.
8R, VP3	Guyana
8Z4	Saudi Arabia/Iraq N.Z.
9A1, M1	Republic of San Marino

Prefix	Country
9G1, ZD4 (from 5/3/57)	Ghana
9H1, ZB1	Malta
9J, VQ2	Zambia
9K2	Kuwait
9K3, 8Z5	Kuwait/Saudi Arabia N.Z.
9L1, ZD1	Sierra Leone
9M2, 4 (from 16/9/63)	Western Malaysia
9M6, 8 (from 16/9/63)	Eastern Malaysia
9N1	Nepal
9Q5, OQ5, 0	Republic of the Congo
9U5 (from 1/7/62)	Burundi
9V1, 0, VS1, 9M4 (prior to 16/9/63 or after 8/8/65 only. From 16/9/63 to 8/8/65 counts as 9M2 — Western Malaysia)	Singapore
9X5 (from 1/7/62)	Rwanda
9Y4, VP4	Trinidad and Tobago
*	Blenheim Reef
*	Geyser Reef

*Since there is no apparent claim by any country to these reefs, no prefix will be shown. Confirmation for contact only after 4/5/67 will be accepted for D.X.C.C. credit.

DELETED COUNTRIES LIST

C9 (prior to 16/9/63)	Manchuria
CN2 (prior to 1/7/60)	Tangier
CR8 (prior to 1/1/62)	Damao, Diu
CR8 (prior to 1/1/62)	Goa
EA9 (prior to 13/5/69)	Ifni
ET2 (prior to 15/11/62)	Eritrea
FF8 (prior to 7/8/60)	French West Africa
FI8 (prior to 21/12/50)	French Indo-China
FN (prior to 1/11/54)	French India
FQ8 (prior to 17/8/60)	French Equatorial Africa
I1 (prior to 1/4/57)	Trieste
I5 (prior to 1/7/60)	Italian Somaliland
JZ0 (prior to 1/5/63)	Netherlands New Guinea
PK1, 2, 3 (prior to 1/5/63)	Java
PK4 (prior to 1/5/63)	Sumatra
PK5 (prior to 1/5/63)	Netherlands Borneo
PK6 (prior to 1/5/63)	Celebes and Molucca Is.
UN1 (prior to 1/7/60)	Karelo-Finnish Republic
VO (prior to 1/4/49)	Newfoundland
VQ6 (prior to 1/7/60)	British Somaliland
VS4 (prior to 16/9/63)	Sarawak
VS9H (prior to 29/11/67)	Kuria Muria Is.
ZC5 (prior to 16/9/63)	British North Borneo
ZC6 (prior to 2/7/68)	Palestine
ZD4 (prior to 6/3/57)	Gold Coast, Togoland
9M2 (prior to 16/9/63)	Malaya
9S4(prior to 1/4/57)	Saar
9U5 (from 1/7/60 to 1/7/62)	Ruanda-Urundi.

Y.R.C.S. Notes — cont.

During the first four months of this year the following Youth Radio Club Certificates have been issued to successful students.

Prince Alfred College Radio Club

Elementary Certificates:
- Mark Gryst, Honours.
- Jack Gilding, Honours.
- William Crowley, Credit.
- Anthony Cox, Pass.
- Philip Harper, Pass.

Junior Certificates:
- David Jarvis, Honours.
- William Cowley, Honours.
- Jack Gilding, Pass.

Port Pirie Youth Radio Club

Elementary Certificates:
- Rodney Wallace, Honours.
- Shane Clarke, Credit.
- Mark Meaney, Pass.
- Paul Thomas, Pass.

Elizabeth Youth Radio Club: From reports received the tour of inspection of the A.B.C. broadcast transmitter station made by members of the club was most enjoyable. Members were transported to the transmitting site at Pimpala by the club instructors and parents.

VICTORIA

Camberwell Grammar School Radio Club: The Camberwell Grammar School Radio Club has got away to a good start in the first half of 1970, with 13 new members commencing the Elementary and Junior Certificate Courses. Three members sat for the amateur licence examination in February. They were, Robert Wills who sat for the A.O.C.P., while Alan Conrad and John Frost for the L.A.O.C.P.

The office bearers for 1970 are:
- President: Robert Wills.
- Secretary-Treasurer: John Frost.
- Equipments Officer: Alan Conrad.

It was recently learned that the Victorian Schools and University Examination Board has approved the Youth Radio Scheme Courses, up to and including the Senior Certificate, as a Leaving Certificate subject at the Camberwell Grammar School. This will no doubt prove to be a benefit and an added incentive to club members.

Constructional projects being considered at the club include a press-to-talk relay system for the club station transmitter. Under construction is the "E.A." Transistorised Dip Oscillator. It is also proposed to construct a 144MHz station for participation in local inter-school lunch time nets. Equipment donated by Mr Wardle is being used in these projects.

Club secretary, John Frost reports that the prospects for 1970 are excellent, with a possibility of members gaining up to 30 Y.R.S. certificates. In addition the projects in hand are the most ambitious in the club's history. ■

LISTENING AROUND THE WORLD

Summary of European signals

Our six-monthly review of reception of signals from Europe for our winter periods shows that daytime reception is good, and that there is less use of the higher frequencies.

by Arthur Cushen

ALBANIA: Radio Tirana provides programs in English 18 times a day for reception in various parts of the world. In New Zealand and Australia the transmission at 0630GMT gives the best reception on 9495KHz. A further trnsmission for morning listening at 2000GMT is also well received on 7090KHz.

AUSTRIA: Radio Vienna has recently added some English programs to its schedule, and reception of this 15 minute feature is best at 0530GMT. Three frequencies are in use: 6155, 7245 and 17740KHz. A transmission to Australia and New Zealand is from 1000 to 1200GMT on 17855KHz but during our winter reception is poor. Also there is now interference on the frequency from Radio Japan.

BELGIUM: Radio Belgium at Brussells is another station which has increased its English programs. Reception is best at 0050-0100GMT on 17720KHz. This same transmission is carried on 15335KHz, but reception is poor. A transmission of the home program is heard at 0530GMT on 17780KHz.

BULGARIA: Radio Sofia has several transmissions in English beamed to Europe, Africa and North America. The broadcasts giving the best reception are:

GMT	KHz
1930-2000	6070, 9700
0000-0100	9700
0400-0430	9700

CZECHOSLOVAKIA: Radio Prague has a special transmission to Australia and New Zealand at 0700GMT, and during the winter its services to North America are also well received:

GMT	KHz
0100-0200	9540, 9630, 11990
0300-0400	7345, 9540, 11990
0700-0800	6055, 9505, 21485

DENMARK: Radio Denmark in Copenhagen has ceased transmissions in English and now broadcasts only in Danish.

FINLAND: Radio Helsinki is received in our early evening at good level on two frequencies. Transmissions on weekdays between 0600 and 0630 are carried on 9550 and 11755KHz. On Sundays the service is from 0630 to 0655 on the same frequencies. The station has English announcements at the opening and closing of transmissions, which are otherwise in Finnish and Swedish.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are GMT. Add 8 hours for Perth, 10 hours for Sydney 12 hours for Wellington.

FRANCE: The O.R.T.F. in Paris has recently extended its short-wave broadcasts and can now be received on many new frequencies. The two transmissions in English which give the best reception in this area are:

GMT	KHz
0515-0530	7155, 9700, 11920
2015-2100	15295, 17720, 21580

GERMANY (East): Radio Berlin International has a special service in English to the Far East from 1115GMT onwards, but during our winter months reception is poor. The transmission best received at this time of the year is the one commencing at 0645GMT on 21465KHz. Broadcasts to North America at 0330GMT are received on 9730KHz.

GERMANY (West): Radio Deutsche Welle at Cologne has two transmissions in English for Australia and New Zealand, as well as a service in German. The broadcasts in English are 0920-1020GMT, carried on 17800, 17845 and 21560KHz. The service for morning reception at 2100-2200 is on 7130, 9760 and 15275KHz. The German transmission from 0700 to 0910 is best received on 9650 and 21585KHz.

GREAT BRITAIN: The B.B.C. World Service is on the air 24 hours a day, but for Australia and New Zealand it is broadcast for morning and evening reception. The transmission at 0600-0915GMT is on 7150, 9640, 11955 and 15070KHz; and 0900-1115GMT on 11750, 15070, 21550KHz. The morning program at 2000-2245 is on 7120, 9410, 11750, 15070 and 15260KHz.

HOLLAND: Radio Nederlands, Hilversum, Holland, has several transmissions in English and Dutch for the Pacific area, direct from Hilversum as well as through its relay station at Bonaire.

English broadcasts are:

GMT	KHz
0630-0750	11730
0800-0920	9715
0930-1050	21495

Dutch broadcasts are:

GMT	KHz
0630-0750	9715
0800-0920	11730
0930-1050	21570

HUNGARY: Radio Budapest has several English transmissions, now broadcast to the following schedule:

GMT	KHz
1930-2000	6235, 9833, 11910
0400-0430	9833, 11910, 15160
0800-0815	15160, 17795, 21665

ITALY: Rome Radio has only one transmission in English directed to this part of the world. This is on the air 2200-2225GMT and carried on 5990, 9710 and 11905KHz. Another program in English from 0425 to 0440GMT is heard on 5990, 6075 and 7275KHz. A broadcast in Italian at 0600-0645GMT is directed to Australia and is carried on 9575, 11810, 15410, 17795 and 21560KHz.

NORWAY: Radio Norway at Oslo has a 30-minute program in English every Sunday, called "Norway this Week." This program is the last 30 minutes of the 90-minute Sunday broadcast. The best reception times and frequencies are:

GMT	KHz
0700-0830	15175, 21655, 21730
1100-1230	17825, 21655, 25730
2100-2230	15175, 17795, 21655

POLAND: Radio Warsaw has only one program which can be heard well in the Pacific area, at 0630-0700GMT on 7125 and 9540KHz. Other transmissions are 1900-1925 on 9525 and 11815KHz and 2030-2100 on 6135, 7145 and 9675KHz.

PORTUGAL: Radio Lisbon has a 90-minute service to Australia and New Zealand from 0730 to 0900GMT. This has a 45-minute program from 0730-0815 which is repeated immediately. Both transmissions are carried on 17880 and 21495KHz. A service to North America 0345-0430GMT is giving very good reception on 11935 and 15125KHz.

ROMANIA: Radio Bucharest transmits on several frequencies for its English broadcasts. A service to Europe 1930-2030GMT in English can be received on 9690 and 11940KHz. Broadcasts to North America 0300-0330 and 0430-0500GMT are broadcast on 6150, 6190, 9510, 9570, 9690, 11810 and 11940KHz. A service to the Pacific 0645-0715GMT is carried on 15250 and 17850KHz.

SPAIN: Madrid is received in its English program to North America 0100-0345GMT on 9760 and 6140KHz. Programs in Spanish are on the air from 2300 to 0500 on 9360 9660, 11710 and 15195KHz.

SWEDEN: Radio Sweden broadcasts in English 11 times a day with programs directed to all parts of the world. The transmissions best received here are:

GMT	KHz
0330-0400	11705
0515-0545	17840
1230-1300	15105
2045-2115	6065, 11705
2245-2315	11705, 15310

SWITZERLAND: The Swiss Broadcasting Corporation in Berne is now operating to a new schedule. This includes broadcasts in English to Australia and New Zealand from 0700-0730 and 0845-0915GMT, carried on 9590, 11775 and 21520KHz. The service to North America gives good reception in the afternoons. It commences at 0400GMT and is on 9535 and 11715KHz.

U.S.S.R.: Radio Moscow uses both medium and short-wave to serve Australia and New Zealand from its transmitting site in Siberia.

GMT	KHz
1100-1130	629, 9750, 12060
1130-1200	629, 1475. 9750

VATICAN: Vatican Radio has two transmissions to the Pacific area:

GMT	KHz
2205-2220	9645, 11745
1125-1140	17845, 21690

During our winter the session at 2205GMT gives the best signal.

YUGOSLAVIA: Radio Belgrade is best received with its program in English during our early morning reception period with broadcasts at 2000 and 2200GMT. Best reception is on 9620KHz, but other frequencies such as 6100 and 7200KHz also carry the broadcasts.

XERMX USING 15125KHz

Radio Mexico, XERMX, has been heard on five frequencies in recent months in its test period, from 2300 to 0600GMT. The station first used 11720KHz, then was noted with a simultaneous transmission, first on 9535 and then 6055KHz. Recently the 31M band signal was noted on 9745KHz, but the 49M band transmission is still observed on 6055KHz at 0400GMT.

The station is now testing on the unannounced channel of 15125KHz, which is giving the best reception of any frequency so far. This new channel is clear of interference from Lisbon at 0430GMT. In the past, station identification, and appeals for reports to Apartado 20100, Mexico City have been heard about every 20 minutes in English, French, German and Spanish. We now observe a short five-minute news bulletin in English on the hour every hour, commencing 0500GMT. Following the news, a 10-minute program in Spanish is presented and then light music for the remainder of the hour program.

RECENT VERIFICATIONS

SPAIN: Radio Nacional de Espana at Madrid has confirmed our reception with a card, letter and pennant for a report on the new frequency of 15195KHz. This transmission to South America is on the air 2300-0500. It is also broadcast on 11710, 9660 and 9360KHz. The station states that its present program schedule is printed only in Spanish. The English transmission to North America is shown as 0100-0345 on 9760 and 6140KHz.

COLOMBIA: Radio Nacional has confirmed our reception of HJCT on 6030KHz with a card, in colour, showing an aerial view of the modern business section of Bogota. The verification was received in three weeks, and lists the shortwave station KJCQ, 4955KHz; HJWT, 6180KHz; and HJZM, 9635KHz.

PHILIPPINES: The Voice of the Philippines confirmed our reception on 9580KHz with a letter from Ernesto Madrid, Manager. The address is National Media Production Centre, Malolos, Bulacan. The verification came by airmail in a response to a report of reception at 0930GMT with English news.

BELGIUM RADIO EXPANDS

The Belgium Radio at Brussels has expanded its overseas service and has been heard on several new frequencies in recent weeks. Excellent reception is being experienced of the program on 17720KHz, which carried 10 minutes of English from 0050 to 0100GMT when the station ends its transmission. This frequency is beamed to South America, while 15335KHz carries the same program to North America, but this frequency suffers from some interference.

The Belgium Home Service is now being relayed on short-wave on a test basis. It was first noted on 17740KHz, but now is heard on 17780KHz, opening at 0525GMT. The station uses a new interval signal for this broadcast and at 0530 has five minutes of news in Flemish, followed at 0535 by a music program.

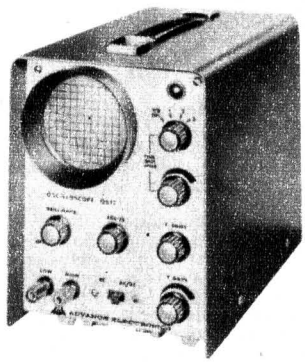
Another new channel is 21460KHz, which opens at 1000GMT with a program beamed to Africa, but there is some interference on the channel from Radio Moscow.

Here are the famous names in OSCILLOSCOPES

together with the standard of service to match

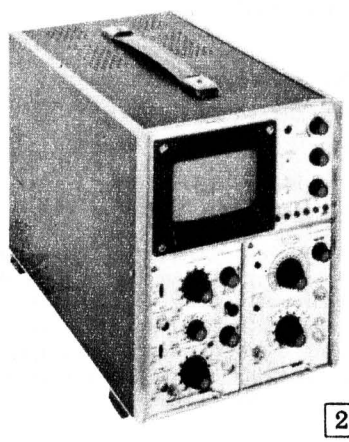
A SELECTION FROM THE OUTSTANDING RANGE OF INSTRUMENTS AVAILABLE FROM JACOBY MITCHELL:

ADVANCE



1

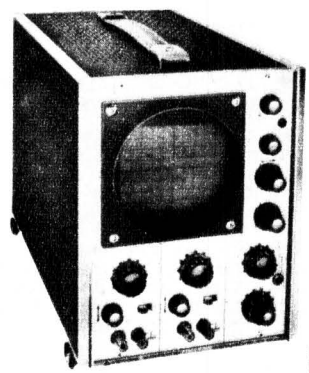
(Above) Model OS12 oscilloscope—designed primarily as a visual aid to students studying science. The Y amplifier has a bandwidth from DC to 30kHz with a maximum sensitivity of 100mV/division and an input impedance of 1MΩ. Time base speeds variable from 100mS/division to 100μS/division.



2

(Above) Model OS2000 is a portable solid state oscilloscope with a bandwidth of 20MHz at a maximum sensitivity of 10mV/cm. Supply rails are stabilised against AC supply variations by a VOLSTAT constant voltage transformer.

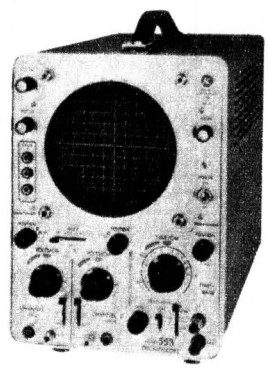
Plug-in time bases and Y amplifiers ensure maximum versatility. There is a choice of single and dual trace and high gain differential amplifiers and standard or delayed time base plug-ins. A rectangular tube with a bright trace together with 200 nanoseconds of signal delay ensure that the leading edge of any suitable waveform is clearly visible.



3

(Above) Model OS25A is a low cost dual trace oscilloscope with internal triggering from either channel. Vertical amplifier bandwidth from DC to 5MHz with a maximum sensitivity of 100mV/cm on each channel. The 5" helical PDA tube gives a bright, clear display.

KIKUSUI



4

(Above) The Kikusui Model 553 is a dual trace oscilloscope with solid state circuitry for high reliability. The 553 operates in a 2 channel mode and employs a vertical differential DC amplifier with a bandwidth of DC–7MHz. The dual trace system displays either channel separately or chops between channels. A wide sweep range of 1 sec to 1μ sec is provided. Model 555, also available, is a single trace version with similar performance.

PROBE KIT

5

Passive Probe Kit GE81004 is for use with instruments having an input resistance of 1 megohm and capacity of 15-55pf. Includes—• sprung hook • probe attenuator 10:1 • UHF male coupling • BNC male coupling • BNC tip • 4mm plug • spike • crocodile clip.

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NEW SCHEDULES OPERATING

BROADCASTS FROM PRAGUE

The following schedule from Radio Prague, Czechoslovakia, is in operation to November 2:

To Europe

GMT	KHz	Language
0800-0930	6055, 9505	German
0930-1100	6055, 9505	German
1100-1200	6055, 9505	French
1200-1300	6055, 9505	Italian
1300-1330	9550, 11965, 15330	English
1630-1700	5930, 7345	English
1700-1730	5930, 7345	Spanish
1830-1900	5930, 7345	Spanish
1900-1930	5930, 7345	English

To Africa

1500-1530	6055, 9605, 11990, 17840, 21735	Czech and Slovak
1530-1630	6055, 9605, 11990, 17840, 21735	English
1630-1730	9605, 11990, 17840, 21735	Arabic
1730-1830	5930, 7345, 9605, 11990, 17840, 21735	English
1830-1930	9600, 11990, 17840	French
1930-2030	5930, 7345, 9600	Arabic
2030-2130	5930, 7345, 9600, 11990, 17840	French

To South and Central America

2130-2230	5930, 7345, 9600, 11990, 15365, 17840	Portuguese
2230-2300	5930, 7345, 9600, 11990, 15365	Czech and Slovak
2300-2400	5930, 7345, 9540, 9630, 11990, 15365	Spanish
0000-0100	5930, 7345, 9540, 9630, 11990, 15365	Portuguese
0200-0300	5930, 7345, 9540, 9630, 11990	Spanish

To North America

0100-0200	5930, 7345, 9540, 9630, 11990, 15365	English
0300-0400	5930, 7345, 9540, 9630, 11990	English

To Far East and Australia

0700-0800	6055, 9505, 11800, 15310, 21485, 21700	English
0800-0830	6140, 21485, 21700	Czech and Slovak

BROADCASTS FROM MOROCCO

The latest schedule of Radiodiffusion-television Morocaine, at Rabat, listing several new frequencies, was recently given in Radio Australia's DX Session. Details of the foreign broadcast service are as follows:

GMT	KHz	Language
1800-0000	6190	Arabic
0630-0900	15345	Arabic
1200-1800	15345	Arabic
0700-0900	15245	French
1200-1400	15245	French
1400-1500	15245	Spanish
1700-1800	11735	English
1800-2230	11735	French
2230-0000	11735	Spanish
0630-0900	9615	Arabic
1800-2200	6170	Arabic
1800-2200	15360	Arabic
2230-0000	15360	Spanish

RADIO CONTINENTAL

Two frequencies have been noted carrying the programs of Radio Continental, OAX6E, Arequipa, Peru. Two relatively new frequencies are now employed but 6055KHz provides the best reception during the last hour of transmission. The station has been heard closing at 0600GMT and using the "Born Free" theme.

The other frequency is 9455KHz and this one has been heard at our listening post from around 0400GMT. Signals are best at this time, being much weaker when the station closes at 0600GMT, when Morse interference is troublesome.

VQ07 USING 7115KHz

The Solomon Islands Broadcasting Service has increased its power on medium-wave and now also has two short-wave frequencies in use. VQO on 1030KHz has been increased to 5KW and is heard in New Zealand at 1100GMT over 3DB in Melbourne.

Two short-wave transmitters are now in service. VQO4, on 3995KHz, has been active for some years, and has been joined recently by VQO7 on 7115KHz, which carries the same program from 0700 to 1130GMT daily.

The station schedule includes a world news summary at 0800, then local news in Pidgin, shipping information and other announcements. At 0900 local news is again presented, but on Sunday this is replaced by B.B.C. world news. At 1000GMT a recordnig of B.B.C. world news is heard week days, and at 1100GMT news is relayed from the A.B.C. A program summary is heard at 0700 and is repeated at 0910GMT.

NEW COLOMBIAN SIGNALS

During the present winter season some new signals from Colombia have been heard during our afternoon listening. One of the best times to hear unusual stations is during some special event in the coun-

NEW RH (Radio House) RANGE OF MULTIMETERS

Model RH-80 $18.00 Postage 50c

20,000 Ohms per Volt DC
10,000 Ohms per Volt AC

Specifications:

DC Volts. 0.5, 2.5, 10, 50, 250, 500, 1000 V

AC Volts. 10, 50, 250, 500, 1000 V

DC Current: 50uA, 5mA, 50 mA, 500 mA

Resistance. 5 kΩ, 50kΩ, 500kΩ, 5 MegΩ

Decibels. —10 + 62 lb

Accuracy. DC±3%, AC ±4% (of full scale)

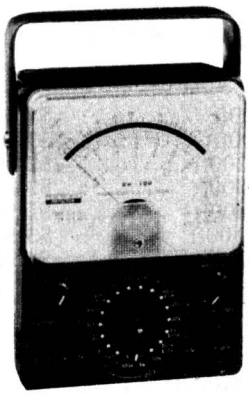
Batteries. Two 1.5V dry cells. Size AA, "Eveready" 915

● Overload-protected by dual silicon diodes. ● Mirror scale. ● Double-jewelled ±2% meter. ● ± 1% temperature-stabilized film resistors.

Model RH-100 $39.75 Postage 75c

100,000 Ohms per Volt DC 10,000 Ohms per Volt AC

● Overload Protected by Dual Silicondiodes ● Double-jewelled ± 2 per cent Meter ● ±1 per cent Temperature-stabilised Film Resistors ● Polarity Changeover Switch ● Mirror scale, instruction for operation with circuit diagram.



SPECIFICATIONS:

DC Volts: **0.6, 3, 12, 60, 300, 600, 1200V (100,000Ω/V)**

AC Volts: **6, 30, 120, 300, 1200V (10,000 Ω/V)**

DC Current: **12μA, 300 μA, 6mA, 60mA, 600mA, 12 amps DC and AC Current 12 amps.**

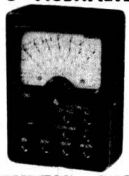
Resistance: **20KΩ, 200KΩ, 2MΩ, 20MΩ**

Decibels: —20 to + 17, 31, 43, 51, 63.

Accuracy: DC±3 per cent, AC± 4 per cent (of full scale)

Batteries: Two 1.5V dry cells, size AA, "Eveready" 915

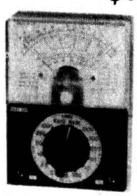
NEW TYPE Y-3 MULTIMETER



MEASURING RANGE: D.C. Voltage: 6V, 30V, 150V, 600V (2000 ohms/V). A.C. Voltage: 6V, 30V, 150V, 600V (2000 ohms/V). D.C. Current: 150 mA. Resistance: 0-100,000 ohms. Complete with 1.5 volt battery and test leads. Size: 3¾" x 2¾" x 1⅜".

Checked, Packed and Posted — $9.50. Limited Stocks.

"HANDYMAN" RH 150 $11.50



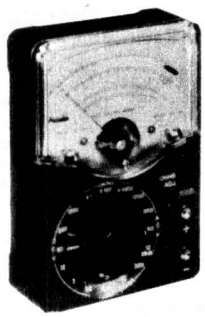
CHECKED PACKED & POSTED FREE

Pocket-size 3¼" x 4½" x 1¼". Instruction sheet and circuit.

SPECIFICATIONS

DC Volts 2½, 10, 50, 250, 1000. AC Volts 10, 50, 250, 500, 1000. DC Current, .1, 25, 250 M/amps. Resistance, 20K and 2 megohms. Decibels, —20db = +62db .7K/c. Capacitance, .0001, .01, .0025, .25 mfd.

Model RH-20 $13.95. Postage 50c



20,000 Ohms per Volt DC
10,000 Ohms per Volt AC

Specifications:

DC Volts: 0.25, 2.5, 10, 50, 250, 1000 (20,000/V)

AC Volts: 10, 50, 250, 500, 1000 (10,000/V)

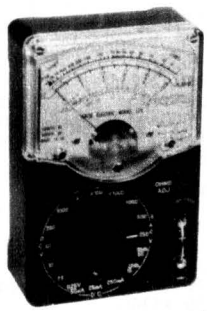
DC Current. 50 uA, 25mA, 250mA

Resistance. 7kΩ, 700kΩ, 7MΩ

Decibels. —10 +22 (at AC/10V) +20 +36 (at AC/50V). Upper frequency limit 7kc.

Batteries: Two 1.5V dry cells. Size AA, "Eveready" 915

Model RH-55 $20.00 Postage 50c



30,000 Ohms per Volt DC
14.000 Ohms per Volt AC

SPECIFICATIONS:

*DC Volts: 0.6, 3V, 12V, 60V, 300V, 1200V (30,000 ohms/V.

*AC Volts: 12V, 60V, 300V, 1200V (14,000 ohms/V).

*DC Current: 60 A, 12mA, 300mA.

*Resistance: 10K ohm, 1Meg ohm, 10Meg ohm.

*Decibels: -10 db +23 db.

Model RH-60 $25.00 Postage 50c

50,000 Ohms per Volt DC
10,000 Ohms per Volt AC

Specifications:

DC Volts: 0.25, 2.5, 10, 50, 250, 500, 1000 V

AC Volts. 10, 50, 250, 500, 1000 V

DC Current. 25 uA, 5 mA, 50 mA, 500 mA

Resistance: 10 kΩ, 100 kΩ, 1 MegΩ, 10 MegΩ

Decibels. —10 +62 db

Accuracy: DC±3%, AC± 4% (of full scale)

Batteries. Two 1.5 V dry cells. Size AA, "Eveready" 915

Models RH-80, -55, -60 are:—

● Overload-protected by dual silicon diodes ● Mirror scale ● Double-jewelled ±2% meter ● ±1% temperature-stabilised film resistors.

TAPE RECORDER BOOK TYPE

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The latest model portable Tape-recorder. 4 transistor, 3in reels, 2 tracks. Instruction manual. Size 10½in x 7in x 1½in.

Just open the book and record. Supplied complete with tape, microphone and batteries. Special discount price, **$20.50, posted anywhere.**

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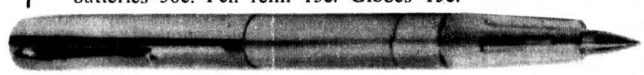
Lights up automatically when pen cover is in position for writing. **$2.00 posted.**

Bright illumination. Modern shape with silver finish. You can write when it is dark. Spare parts available. Two batteries 30c. Pen refill 15c. Globes 15c.



RADIO HOUSE PTY. LTD.

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try, and the elections in Colombia resulted in many stations being heard all night on extended hours. Many of these signals could not be heard under normal conditions because they leave the air before the band in which they operate becomes audible.

Radio Nacional de Colombia, Bogota, has been heard on 6030 and 4955KHz to around 0500GMT. The same program is carried on both channels. A further channel, 9630KHz, is also heard around this time.

HJDD, Radio Valledupar, has been heard on 6175KHz to close down at 0500GMT. The station is at fair level but jamming is troublesome. Another Colombian heard at this time on a nearby channel is HJLW, which has moved from 4790KHz to 6172KHz.

HJIQ, La Voz del Llano, Villavicencio, has also been heard, on 6065KHz. this 1KW station was formerly operating on 6115KHz. The station has been heard signing off at 0500 at fair level.

HJKJ, Radio Emisora Nueva Granada, is heard well in its all-night transmission on 6160KHz, with reception best around 0600. According to station announcements they now have the new mailing address of Emisora Nueva Granada, Carrera 6, No. 35/29, Bogota, Colombia.

VIENNA'S NEW SCHEDULE.

The schedule of Austrian Radio in effect to 6th September shows only a few changes from the one published in the April issue. The alterations are as follows:

GMT	KHz
2000-2200	7110
1600-1800	17865
1200-1400	11860

MOSCOW ON 4825KHz

According to a report in Sweden Calling DXers, Radio Moscow is using the 60M band. Our observations show this transmitter to be carrying the Radio Moscow program for Europe on 4825KHz, and the station has been heard in various European languages from 1600 to 2200GMT.

This band and the 90-metre band are intended for local and regional broadcasts in the equatorial countries, and they are therefore called the Tropical Broadcasting Bands. Radio Moscow is the first station to use one of these bands for international broadcasts.

BEIRUT USING 11925KHz

The Voice of Lebanon is now using a new channel, 11925KHz, replacing 11790KHz, and is heard from 0130 to 0400GMT. English programs are from 0230 to 0300GMT, and this includes news, commentary and music. The transmission up to 0300GMT suffers some interference from Radio Banderantas, Sao Paulo, Brazil, on the same frequency.

Radio Beirut in its service to Africa continues to operate on 15350KHz. Best reception is at 1830 to 1900GMT when the station has a program in English.

EUROPEAN DX COUNCIL

A rapid expansion of the European DX Council has occurred in the past year, with over 6,000 listeners in 30 DX Clubs in 12 European countries joining. This expansion has occurred since the last meeting of the Council in Halmstad in Sweden last June. Having attended that meeting as an observer, the writer was conscious that the Council's aim to co-ordinate the DX activity in Europe within the one organisation was being frustrated by the old constitution, which provides for countries, rather than individual clubs, being approved as members of the Council. Thus many countries, in which several clubs operated, failed to reach agreement on co-operation and representation and, in some countries like Finland and Denmark, two clubs in each had alternative representation on the Council, making progress and liaison difficult.

The European DX Council also has affiliated clubs in other parts of the world, and it plans to aid DXers in national matters by its operation. It is not itself a DX club, but an organisation representing the DX clubs of Europe. The continuous spreading of information and acquiring of new member clubs has been one of the main aims in the past few months, since the European DX Council set-up headquarters in Helsinki.

Some of the recent proposals included drawing up a land list showing the radio countries of the world, by which Dxers can count the countries verified on a world-wide basis. The land list committee had many headaches. A radio country is not always a political country, and a better term than country is advocated. These separate geographic countries have been now listed in print. (For example: territories such as Alaska and Hawaii are counted separate to the United States and there are numerous other similar cases.)

Some of the other committees now being instituted to help in various fields include committees to devise means of improving reception reports, competitions, with manufacturers liaison contests, propagation research, and others; in fact 12 committees have been formed.

The European DX Council is to hold its 1970 meeting in Cologne from July 24 to July 26. The address is: The Secretary General, European DX Council, P.O. Box 14110, Helsinki 14, Finland.

U.S.S.R. BROADCASTS MOST HOURS

A recent survey of the broadcasting hours of various internatoinal stations shows that the U.S.S.R. broadcasts more program hours a week than any other country. The major broadcasters at present are U.S.S.R., 1,920 hours per week; Communist China, 1,469; Voice of America, 841; United Arab Republic, 774; Great Britain (B.B.C.), 730; West Germany, 554.

CANADIAN PRIVATE STATIONS

From time to time, readers report the reception of some of the low-powered short-wave stations in Canada which relay the programs of their parent medium-wave station for 24 hours a day. All these programs are of a commercial nature, and all stations operate in the 49M band. Over the years all have been heard and verified, and the powers range from 10W to 1KW.

CFCX, Montreal, 6005KHz, 500W, operated 24 hours a day, and relays CFCF Montreal on 600KHz. Reception of this, and all other stations listed, is best around 0700 to 0900GMT.

CFRX, Toronto, 6070KHz, 1KW, relays CFRB using medium wave on 1010KHz. CFRX, operated by Rogers Radio, is the most consistent signal.

CFVP, Calgary, Alberta, on 6030KHz with only 100 watts, is the lowest powered signal which can be heard. It relays CFCN "The Voice of Calgary" which uses 1060KHz.

CHNX, Halifax, Nova Scotia uses 6130KHz with 500W.

CJCX, Sydney, Nova Scotia, on 6010KHz with 1KW, relays CJCB, and is regarded as the eastern-most station on the Canadian mainland.

CKFX Vancouver, British Columbia, uses 6080KHz and the power of 10 watts. This station was heard some years ago, but the congestion of 6080KHz these days makes reception of the signal now almost impossible.

BROADCAST BAND NEWS

NEW ZEALAND: The New Zealand Broadcasting Authority recently granted the first two private commercial radio station licences for stations to operate from Auckland. The successful applicants were Radio Hauraki and Radio International. Radio Hauraki has been operating off-shore on 1480KHz from November, 1966, and is to move to its land base station shortly. In the meantime, the off-shore station is to be closed. Radio International was successful in a tender for time on 1ZM Auckland on 1250KHz and operate a commercial program from 1800-2100GMT Sunday to Friday and from 1000-1200 from Monday to Saturday.

The authority also called for applications for stations in Hamilton, Christchurch and Dunedin. The Christchurch applicants have been turned down, and no licence is to be issued. A licence has been issued for Hamilton to the Independent Broadcasting Company which plans to have studios in Hamilton, and later repeater transmitters on the Hauraki Plains.

SOUTH VIETNAM: The complete list of American Forces Vietnam Network stations has been received by Keith Barton and published in the Australian Radio DX News.

KHz	KW	Location
540	50	Saigon
560	50	Pleiku
770	10	Qui Nhon
850	10	Da Nang
900	10	Nha Trang
1200	1	Chu Lai

The power of Nha Trang is shortly to be increased from 10 to 50KW. Reports should be addressed to American Forces Vietnam Network, O.I.C., Network Radio Branch, A.P.O., San Francisco 96309, U.S.A.

JUST RELEASED

Pre-Pak Electronics present for the first time in Australia their new range of easy to build kits based on the Plessey 403/A integrated circuit. The kits contain all parts and instructions to enable you to build a range of audio amplifiers suitable for operating from crystal or ceramic cartridges.

The Plessey SL403/A may be purchased separately, $10.50. Post 25c.

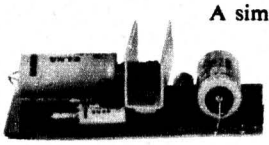
PERFORMANCE, CHARACTERISTICS

		SL403A
Output RMS.		3 watt
Input impedance.	Preamplifier.	20MΩ
	Main amplifier.	100MΩ
Distortion.	Preamplifier.	0.1%
	Main amplifier.	0.3%
Frequency Response.	Lower 3db point.	20Hz
	Upper 3db point.	30KHz
Operating voltage.		+18V
Minimum operating load.		7.5Ω

Kit MA1

BASIC AMPLIFIER KIT

A simple amplifier based on the SL403A.



$12.50. Post 10c.

SPECIFICATION

Sensitivity		270MV R.M.S.
Input impedance	Vol max	700KΩ
	Vol min	2mΩ
Frequency response		30Hz-90KHz
Distortion		0.5%
Noise level		−84db
Hum level		−63db
Quiescent current		60mA
Current consumption at 3W		350mA

KIT MA2

BASIC AMPLIFIER KIT

As above, but including case and volume control with knob.
$14.50. Post 25c.

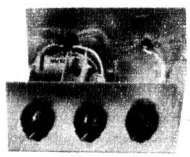
KIT MA3

DELUXE MONO AMPLIFIER KIT

A 3 watt mono amplifier with bass and treble controls.

SPECIFICATION

Sensitivity	2.7 watt	160mV R.M.S.
Frequency response		15Hz-50KHz
Tone control range	Bass (40Hz)	−17db +10db
	Treble (15KHz)	−15db +11.5db
Distortion		Less than 1 per cent
Noise level	(Ref 2.7 watt)	−80db
Hum level	(Ref 2.7 watt)	−72db



$15.90
Post 25c

Complete with chassis and knobs.

KIT MA4

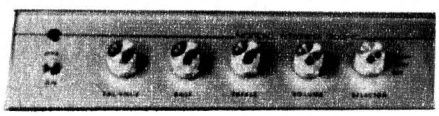
DELUXE MONO AMPLIFIER KIT

As above, but with built-in power supply and mains lead.
$23.90. Post 50c.

KIT S.A.1

DELUXE STEREO AMPLIFIER KIT

A 3+3 watt R.M.S. Stereo Amplifier complete in every detail. Separate bass and treble controls.



Complete with case and knobs $46.00
Chassis only, without case .. $42.00
Post 50c.

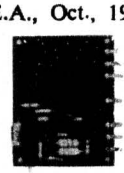
Sensitivity	(2.7 watt)	160mV R.M.S.
Input impedance	Vol max	700KΩ
	Vol min	2mΩ
Frequency response		15Hz-50KHz
Tone control range	Bass (40Hz)	−17db +10db
	Treble (15KHz)	−15db +11.5db
Distortion		Less than 1 per cent
Noise level (2.7 watt cont. level)		−80db
Hum level (2.7 watt cont. level)		−72db
Cross talk level		−40db

KIT P.S.5 A power supply kit for use with any of the above amplifiers. Output 18V, Max current IA.
Price **$6.40.** Pose 50c.

MAGNETIC PREAMPLIFIER KITS

For assembly on printed circuit board. (All parts supplied.) As E.A., Oct., 1965.

M.P.1 MONO PREAMPLIFIER FOR MAGNETIC CARTRIDGES **$4.90**
M.P.2 STEREO PREAMPLIFIER FOR MAGNETIC CARTRIDGES **$9.00**
M.P.3 MONO PREAMPLIFIER FOR TAPE HEADS (state speed) **$4.90**
M.P.4 STEREO PREAMPLIFIER FOR TAPE HEADS (state speed) **$9.00**
Metal case and input/output sockets **$3.00** extra.



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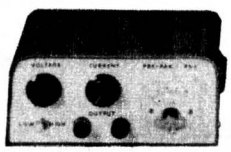

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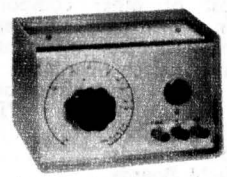
A four transistor, overload protected, DC power supply with metering facilities. Features: Max. voltage 22V, max. current 1 amp, low ripple, easy to assemble and use.

KIT PS. 3. Price $5.95. Post 50c. A general purpose DC power supply kit for experimenting, etc., complete with transformers, rectifier and 1000 mfd electrolytic capacitor on a base plate. Output voltage 7V, 9V, 12V, 15V DC max. current IA.

KIT PS.4.
A general purpose DC power supply kit for experimenting, etc., complete with transformer, rectifier and 2000 mfd electrolytic capacitor. Output voltage 32V, 29V, 27V, 24V, 22V, 20V DC max. current IA.

KIT A.O.1.

HIGH PERFORMANCE AUDIO OSCILLATOR KIT



Specification:

Frequency Range:	15Hz—20KHz.
Output Voltage:	0-1V 0-5mV R.M.S.
Distortion:	Less than 0.1 per cent 60Hz-20KHz.
Output Level:	Within 0.5db over frequency range.

A most useful piece of test equipment for any service shop or workshop.
Price includes recommended battery. **$14.50.** Post., 25c.

KITS DESIGNED FOR THE MOTORING ENTHUSIAST

KIT C.D.1.
Deluxe Capacitor Discharge Ignition Kit. All parts required to build this proven system with full assembly and fitting instructions.

$27.75
Post 50c

SPECIFICATIONS:

Voltage Supply, 3V to 18V DC, Peak DC output (100 pps loaded with coil), 400V, Rise Time 1.5ky per microsecond, Secondary voltage (with standard coil) 20Kv over 2cM GAP, Dimensions, height 4 inches, width 2¾ in., length 6 inches.

Improves starting, petrol consumption, points life, plug life, acceleration, general performance.

KIT C.D.2: As above but for positive earth. Price and availability on application.

KIT W.1: Windscreen Wiper Control Kit. For pulsed operation in light, showery weather. A solid state version of this useful device 4 speeds, on dash-mounted switch, **$6.95**, post., 10c.

KIT W.2: As above but for positive earth. Price and availability on application.

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Containing a variety of NPN and PNP germanium transistors and a host of other components, these 4in x 2½in boards are supplied with free technical information on all parts. Each board has a minimum of 4 transistors.

	PRICE	POST
100 Boards	20c ea.	50c
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Discharge Ignition by Summit.
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6 months' guarantee.

Deluxe	$39.95
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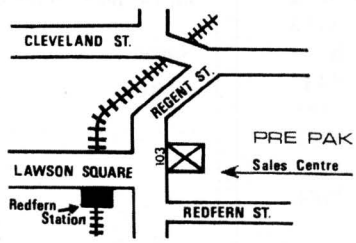

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Hi-Fi Twin Cone, 8 or 15 e.

6½" 30Hz-15KHz 6w	$12.00
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3½" 5-16KHz 12w	$3.30
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12" 15w Twin Cone	$20.00
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AT66
20Hz-20KHz ± 2db
Tracking weight .5-2.5 grams.
$10.30
AT33 **$16.00**
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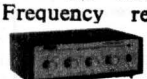
Simple fitting instructions included.

PK.3 PRINTED CIRCUIT BOARD KIT

Contains all necessary ingredients to make your own printed circuit boards.
$3.50 Post 25c

PEAK STEREO AMPLIFIER

3.5 watt per channel.
Frequency response 50-20 KHz
Input 200 mV
Custom made oiled walnut cabinet.



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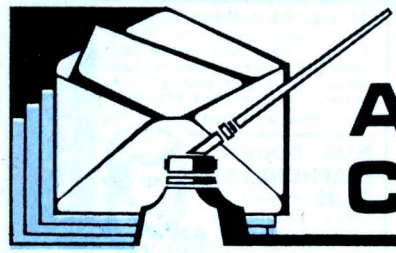


ANSWERS TO CORRESPONDENTS

INTERCOMS: I enjoy reading your magazine very much, especially the interesting features each month. I would like to inquire about a circuit for a simple intercom system, and also the circuit for a transistorised record player. **(A.L., Stafford, Qld.)**

● We have a few isolated circuits for intercoms, the most recent being the "Two Unit Transistor Intercom" published in August, 1962. (File No. 1/IA/9). Modifications were published in March, 1963, for the switching (File No. 1/IA/10). In October, 1968, we showed how it would be possible to convert an ordinary radio to an intercom system, while still carrying out the functions of a radio. (File No. 1/IA/12.) Our last portable record player was published in January, 1964. This was based on a commercial packaged amplifier, which is probably no longer available. In the highly competitive field of simple mono players, it may well be that you can buy more cheaply than you can build. However, we are not in a position to comment on the merits of commercial products.

BASIC RADIO COURSE: I have been reading your October, 1963, issue. Can you send me the series of articles "Basic Radio Course" as this issue has only Chapter 3 in it? **(G.L.A., Caboolture, Qld.)**

● The series of articles, entitled "Basic Radio Course," were published in book form under that title. This has been revised and is now available as "Basic Electronics." We reviewed this latest edition in the March, 1969, issue in our "Technical Books and Publications" section. Copies ot "Basic Electronics" are available through the Information Service for $2.20 including postage.

AMPLIFIER PROBLEMS. Having constructed the Playmaster 115 stereo amplifier, I have struck several problems which may be of interest to other readers. Firstly, can the amplifier be run without a load and during the setting up is a load attached to measure the voltage across the ouput transistors? Having set up the amplifier, I get a low hiss out of the loudspeakers, and there is slight distortion on the louder parts of records. The input impedance of the amplifier is 1.5M. What happens when a lower impedance cartridge is used? The total output power from the amplifier at the moment is only 3 or 4 watts. Another problem is that when the plug is removed from the power point with the volume at maximum, the 500mA fuse blows. **(R.H., Beaumaris, Victoria.)**

● Transistorised amplifiers, in fact, most amplifiers, should have the appropriate load connected to the outputs whenever power is applied, otherwise there is the risk of damage to the output components. From the general trend of your comments, we suspect that you may be trying to operate the Playmaster 115 with ceramic input stage from a magnetic cartridge. If this is the case, it would account for most of the problems you are experiencing, "distorted" sound, low sensitivity, and poor signal-to-noise ratio. You appear to be operating the amplifier with the volume control fully advanced, which would certainly not be necessary under normal operating conditions. The low hiss you refer to is normal in high gain amplifiers when the volume control is in the fully advanced position.

HELP WANTED: Recently I commenced a correspondence course in electronics. However, I am having difficulty in applying some of the principles that I am studying. Because of shift work I am unable to attend a school course but was wondering if some reader would be kind enough to assist me in solving a few problems in his spare time **(D.G., Richmond, Victoria.)**

● We are publishing your address as requested, D.G. Readers in the Melbourne area who may be in a position to assist, should contact: Mr D. P. Graham, Flat 7, 285 Punt Rd, Richmond, Vic., 3121. Phone 42 6168.

COMPUTERS: I am interested in your publication "An Introduction to Digital Electronics." I would like to know if the computer described is an electronic type using transistors, or a relay type. Also, in what recent issues have you published circuits for: a 6 transistor BC and SW receiver; a simple low cost oscilloscope; and a simple aerial. **(J.B., Ryde. N.S.W.)**

● Firstly, we would like to point out that no constructional details for any computers are described in "Digital Electronics." This book traces the history of digital techniques and examines them in the light of present day knowledge. It does describe the theory and the operation of digital computers, and also gives constructional details of a "Digital Demonstrator," on which the operations of a computer can be simulated or demonstrated. Its ability as a computer, however, is limited to 1 plus 1 equals 2, or 1 plus 1 is not equal to 1. Details of constructional projects requested are as follows: We have not published a six transistor receiver for more than 12 years. However, our "All Wave Two," published last month, may interest you as there are a number of transistor functions in the IC. (File No. 4/TR2/5.) Our latest, and probably one of the simplest and least expensive oscilloscopes was described in April, 1968. (File No. 7/C/25.) You have not stated the band intended to cover with the aerial, but a good, all-round SW aerial is the "Twin Doublet," described in November 1963. (File No. 2/AE/13.)

RECEIVERS AND INTERCOMS: Could you possibly give me any "Electronics Australia" refs. for the following: A simple broadcast receiver of about 3 watts audio output using a mains supply (solid-state). The "Little General of 1961" — of which I have a copy — is too bulky for the confined space I have available. Also, a solid-state intercom. set with a mains supply, having a low output (say 10 watts max.), and, if possible, 3 or 4 branches. **(B.E., Cowra, N.S.W.)**

● Unfortunately, we have little that would help you directly, since we do not normally feature simple transistor receivers designed for mains operation. We deliberately design most of these for battery operation in the interest of simplicity, economy, and the convenience of a self-contained unit. However, we have described a number of power supplies suit-

"ELECTRONICS Australia" Information Service

As a service to readers "ELECTRONICS Australia" is able to offer: (1) Photographs, dye-line prints and other filed material to do with constructional projects and (2) A strictly limited degree of personalised assistance by mail or by reply through the columns of the magazine. Details are set out below:

PROJECT REPRINTS: For a 20c fee, we will supply data, as available from our files. The amount of data available varies but in no case does it include material additional to that already published in the magazine. For complicated projects involving material extracted from more than one issue, an extra fee may be requested. As a rule, requests for project data will be answered more speedily if the projects are positively identified and the request is not complicated by questions requiring the attention of technical personnel. Where articles are not on file, we can usually provide a photostat copy at 20c PER PAGE.

PHOTOGRAPHS, DYE-LINE PRINTS: Original photographs are available for most of our projects, from 50c plus 8c postage for a 6in x 8in glossy print. In addition, metalwork dye-line prints are available for most projects for 50c each; these show dimensions and the positions of holes and cut-outs but give no details of wiring.

BACK NUMBERS: A fairly good selection is available. On issues up to six months old the cost is the face value, plus 5c surcharge. From seven to 12 months, 10c surcharge; over 12 months, 20c surcharge. Package and postage is 10c extra per issue. Please indicate whether a PROJECT REPRINT may be substituted if the complete issue is not available.

REPLIES BY POST: This provision is made primarily to assist readers in matters relating directly to articles and projects published in "ELECTRONICS Australia" within the last 12 months. Note, however, that we cannot provide lengthy answers, undertake special research or modifications to basic designs. A 20c query fee must be enclosed with letters to which a postal reply is required; the inclusion of an extra fee does not entitle correspondents to special consideration.

OTHER QUERIES: Technical queries which fall outside the scope of "Replies by Post" may be submitted without fee and may be answered through the columns of the magazine at the discretion of the Editor. Technical queries will not be answered by interview or telephone.

COMMERCIAL EQUIPMENT: "ELECTRONICS Australia" does not maintain a directory of commercial equipment, or circuit files of commercial or ex-disposals receivers, amplifiers, etc. We are therefore not in a position to comment on proposed adaptation of such equipment, or on its general design. "ELECTRONICS Australia" does not deal in electronic components. Prices, specifications or other assistance must be sought from the appropriate advertiser or agent.

REMITTANCES: These must be in a form negotiable in Australia. Where the charge may be in doubt, an open cheque, endorsed with a limitation, is recommended.

ADDRESS: All requests for data and information, as set out above, should be directed to The Assistant Editor, "ELECTRONICS Australia," Box 2728 G.P.O., Sydney, N.S.W. 2001: 5/69

ANSWERS—continued

able for these and similar receivers, and it may be possible for you to select a battery operated design and combine it with a power supply. For a receiver we suggest the "Mullard Cordless Mantel Receiver" of October, 1961 (File No. 4/TR5/1) and for power supplies the article in the April, 1966, issue "DC Power Supplies" (File No. 2/PS/16.) We have not described any intercom. units of the type and power which you require. Our latest intercom was a two-unit battery operated type described in August, 1962 (File No. 1/IA/9.) In this regard it should be noted that there are many commercial intercom. units currently available at very attractive prices. It may well be that these would cost less than the components for a home-made system. This possibility should be investigated before a desision is made.

HUM PROBLEM. I am using a separate power supply transformer with rectifier bridge and resistor, with 240V taken off from the power input to my 10-10 amplifier, to power my May, 1968, broadcast tuner, but have a problem of hum, possibly earth hum. Could you suggest a way of rectifying this problem, if possible, taking power directly from the amplifier, but the tuner boards completely separated, say 18in. **(R.C., Hawthorndene, S.A.)**

● We suspect that the most likely cause of the hum is insufficient filtering in the makeshift power supply, but since you do not give details of the filtering used, we cannot comment. We suggest you examine the filtering arrangements in other circuits, and experiment to find a more effective set-up for your purpose.

GUITAR AMPLIFIER: A friend of mine is just starting to play the electric guitar. He requires a small amplifier of around 5 to 10 watts, using valves, that could be made at home. Has "Electronics Australia" published a suitable design? **(G.T., Mordialloc, Vic.)**

● Our Playmaster 102 Guitar Amplifier, published in three parts in October to December, 1962, is the nearest to meeting your friend's requirements. He could build the basic version to begin with. It has a power output of 14W. Copies of the articles are available through the Information Service for 20c each. (File No. 1/GA/4 to 6.)

ECONOMY STEREO. I was recently given a turntable and pickup arm complete and I also have two loudspeakers about 12in x 8in, 8-ohm voice coils, which are in perfect condition. I want to build a suitable stereo amplifier costing no more than $30, either transistor or valve, able to work directly from the pickup without preamplifier. Can you help me with a suitable design? Also, what would be an easy and effective baffle for the loudspeakers? **(M.F., Brisbane, Qld.)**

● In general, stereo amplifiers capable of reasonable quality reproduction cost considerably more than $30 to build, let alone buy ready built. However, we draw your attention to the Basic Stereo Amplifier from oddment parts described in the June, 1966, issue, which you may be able to build within your budget by salvaging parts from old equipment. Reprint material is available through the Information Service for 20c. (File No. 1/SA/24.) Details of compact loudspeaker enclosures of the infinite baffle type were given in the September, 1965, issue. (File No. 1/SE/15.) You may be able to adapt one of these to your requirements. However, it may be preferable to contact the manufacturer concerned, in the hope that they can suggest something specifically intended for the loudspeakers you have.

LOUDSPEAKER ENCLOSURES: Can you please advise me on the design and construction of hi-fi loudspeaker enclosures. If this is not possible, can you please recommend any suitable text covering this subject? As I have had little previous experience with hi-fi systems, I would appreciate any information available. **(R.R.V., Niddrie, Vic.)**

● We have published a number of articles on the construction of loudspeaker enclosures. Among our more recent designs, we can supply copies of each of the following

Power ratings

Your article on "Loudspeaker Power Ratings" (May, 1970, P. 112) seems to evade the issue, leaving the operator to be careful and hope that there are no unfortunate accidents. A very simple form of protection not mentioned in the article, but standard advice by American hi-fi manufacturers, is to put a fuse in series with each loudspeaker unit. Inexpensive fuseholders, which mount in the loudspeaker lines can hold the fuses, without running into catastrophic costs. Manufacturers' data are available on fuses and it is an easy matter to calculate a suitable fuse. Typically, a 1A fuse blows at 2A, plus or minus 25 per cent. Fuses are made in values incremented by roughly 1.5, representing, at worst, a 50 per cent overload. (a 230 per cent overload is possible with a 50W amplifier hooked to 15W loudspeakers). Alternatively, a fuse could be chosen experimentally as the minimum size which will not blow with normal listening. This would certainly protect against accidents. Surely this is a reasonable solution for a reasonable problem and one that is by no means original. **(D.B., W. Pymble, N.S.W.)**

● Admittedly, the article should have contained a reference to the use of fuses, which are just as systematically omitted by some designers as they are included by others. We have not done any work with fuses in this role and cannot draw on experience as to the protection they might offer against their nuisance quality, if selected to operate within the tight margin between normal audio peaks and the official power rating of the loudspeaker system. Undoubtedly, they would be able to protect a system against a gross overload due to some operating accident but this was really not the problem we were concerned with. This was to answer the question: "Can modestly powered loudspeakers be used with an amplifier having a much higher power rating per channel?" Our advice, broadly, was: "Yes, provided the loudspeakers are operated in the kind of environment and at the loudness levels for which they were intended." We specifically warned against "showing off" for visitors or seeking exaggerated bass output. Implicit in the article was the conviction that, if the loudspeakers are to be damaged, it would probably not be by a short-term overload (last par. p. 113) but by longer-term use at a level which was merely indiscreet. We would have to be convinced that fuses could be selected to safeguard against mere indiscretion without opening on occasional audio peaks. The behaviour of fuses in this role would be all the more complicated by the fact they they would be trying to operate in conjunction with a load circuit whose impedance (and therefore tolerance to over-voltage) varied widely with frequency. Readers may be able to contribute to this discussion from actual experience.

ANSWERS – continued

articles through the Information Service for the usual 20c each: Playmaster 109 Bookshelf Loudspeaker, December, 1964 (File No. 1/SE/13); Playmaster Bookshelf, 7.5 ohms version, July, 1965 (File No. 1/SE/14); Compact Loudspeaker Enclosures, September, 1965 (File No. 1/SE/15); Playmaster Point Four Loudspeaker System, February, 1968 (File No. 1/SE/18); Free-Standing Loudspeaker System, July, 1969 (File No. 1/SE/20.)

DISTORTION: In the July, 1967, issue the power output of the modified version of the Unit 4 Playmaster is quoted as 8.5 watts prior to clipping but the distortion is quoted at only .42 per cent of 8 watts. What is the difference between clipping and distortion? Does the action of fully automatic turntables have any adverse affect on LP records? Would it be possible to design a loudspeaker enclosure round a single Rola 12PX speaker since 12in speakers give superior bass and few people would be able to hear over 12KHz anyway? **(C.K., Rose Park, S.A.)**

● When an amplifier reaches the limit of its power handling capability, the output waveform is no longer able to, even approximately, follow that of the input signal. Due to saturation effects in the output stage, further increase in the input signal level results in severe limiting or clipping of the peaks of the output waveform which, in turn causes a rapid rise in the overall distortion. The degree of distortion present before clipping is a function of several other factors causing non-linear amplification in one or more stages. By suitable design this is held to very low values right up to the point of overload and the onset of clipping. Most modern automatic turntables have negligible effect on the surface condition of L.P. records, due to a smooth operating action.

The use of a single speaker in an enclosure is quite permissible and we would suggest you contact the manufacturer directly for specific enclosure data relative to the unit you have on hand. While it may be true that many people are unable to hear frequencies above say, 12KHz, this does not mean that there is no point in using more than one speaker in a system. By splitting the audio spectrum into sections, and allocating a speaker to each section which is designed for the job, it is often possible to obtain a smoother response and also a significant reduction in intermodulation.

HIGH-POWER STEREO AMPLIFIER: The article on the Playmaster 128 Stereo Amplifier in the January, 1970, issue of "Electronics Australia" states on page 67, that, "if a more suitable power transformer was available, the power output could be increased to a full 64 watts per channel." The Ferguson PF115 transformer would appear to be a suitable alternative. If this was used, would the existing power supply components be able to cope with the extra current? If so, could you please inform me of the gate triggering voltage of the C20D thyristor and the current at which it should be triggered so that I may calculate a new value of sensing resistor? **(J.C., Warrnambool, Vic.)**

● The PF115 transformer is suitable but it would require a large chassis as it is a far more bulky unit than that used in the prototype. It is also quite expensive—over $30. The power supply can handle the extra current provided the 2N3055 is mounted on a larger heatsink and the regulator driver transistor is fitted with a clip-on heatsink. The gate triggering voltage of the C20D is 3 volts maximum but typical units are considerably less than this. The thyristor should be triggered at between 4 and 5 amps.

VALVE RECEIVERS: I am planning to make a radio to run off the 240V mains. Would you send me the file numbers and dates of 6 or 5 valve radios, and also details of a 10 to 12 transistor radio to run from either the mains or a 9-volt battery. **(G.M., Mitiamo, Vic.)**

● The "A.B.C. Four," published in March, 1966 (File No. 5/ACR4/44) would probably suit you, G.M. It is a fairly simple broadcast band receiver, capable of quite good performance. We have not described any receiver with 10 or 12 transistors. The "Transporta Six," (File No 4/TR6/2) described in October, 1968, would be the one which comes closest to what you ask for. We understand kits of components are still available from some suppliers. All requests for technical information, reprints, back issues, etc. should be addressed to: The Assistant Editor, "Electronics Australia" Box 2728, GP.O. Sydney. N.S.W. 2001.

SIMPLE VALVE PROJECT: I enjoy reading your magazine. I am only 13 and a beginner in electronics. I have built a couple of simple transistor projects and I would like to try a valve project. I saw a copy of the valve amplifier enclosed with this letter, but no values were given for the components in it. Could you suggest some suitable values for the components and the H.T., L.T., and bias supplies. Also, do you know of a book which I could purchase which gives the meanings of the technical terms used in electronics? This would help as there are a few terms I am not sure of. **(G.L., Moonta, S.A).**

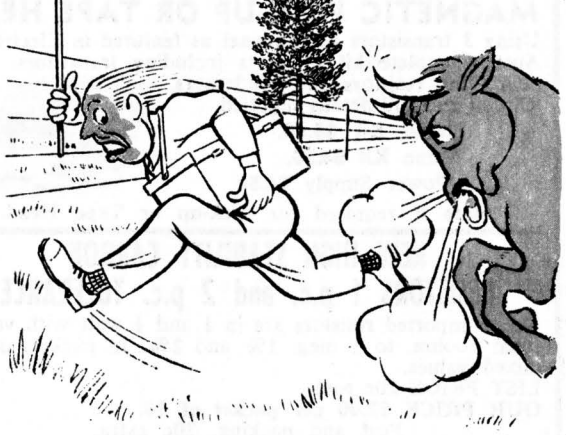
The circuit you have found, G.L., appears to be an explanatory diagram used to describe a standard resistance-capacitance coupled amplifier. A practical circuit would differ from this in some respects; for example, the bias battery would almost certainly be replaced by a resistor or resistor capacitor combination. Because it was an explanatory diagram only, no values would be given. The theory — and some simple circuits — of valve amplifiers, and all the other aspects of radio and electronics, are explained in our publication "Basic Electronics." This will help also in explaining the terms used in electronics. It is available from this office for $2.00 plus 20c postage.

SHORTWAVE RECEIVERS: I would like to construct a three-band superhet receiver and a two-valve shortwave receiver. Can you supply me with all the necessary information? I am not interested in transistors, only valve receivers. **(R.C., Lalor Park, N.S.W.)**

● Our latest two-valve short-wave receiver was the "Simple 3-Band Receiver" published in June, 1967. (File No. 2/SW/41.) It is some time, however, since we have published a three-band superhet receiver. The latest design was the "3-Band Six" of December, 1954. (File No. 5/ACR6/15). For projects of this vintage, however, we can still supply only the circuit and a few essential photographs for the usual 20c fee. If you require the complete articl, it will

RADIO: Unofficial history

The following snippet of radio history (unofficial) was adapted from "DCA News" and from "Grapevine," the latter catering for the technical fraternity in the N.S.W. Division of the Department of Civil Aviation. Specifically credited is Doug. Rowe, of Canberra.



The 33MHz radio range tower was located on the airport; access to the tower itself posed no problem.

The point from which the pattern had to be checked each day was 500 yards away, on private property. A daily task involved locating and verifying the course alignment with the aid of a portable field detector.

The operator would hear dots on one side, dashes on the other, the overlapping pattern producing a continuous tone indicating "on course." Identifying the twilight zone on either side of "on course," where the dots and dashes just merged, called for a lot of concentration during the measurement procedures.

A simple task?

It should have been, particularly on a pleasant day, with the warm sunshine bathing the rural countryside. Or after rain, when mushrooms were sprouting through the grass.

It would have been except for the bull!

You see, the "private property" referred to was a typical farm paddock surrounded by an equally typical 5-strand wire fence. The peg marking the spot where the measurements had to be taken was fifty yards inside the fence and, more to the point, it was the nearest fence!

The bull lived in the paddock and he was far from being a friendly animal.

This situation produced the fastest radio technicians in the whole of the Commonwealth or its territories.

Given a reasonable start, the techs. usually won the 50-yard dash, even when handicapped with the portable field detector.

The 5-strand fence would resonate like the strings on a violin and the slickest course measurements in the history of civil aviation would be completed for another day! ■

NEW RANGE OF RESISTORS CONDENSERS AND POTENTIOMETERS

The resistors are mainly I.R.C. and Morganite and are in a wide range of values from 100 ohms to 3 meg. in ¼, 1 and 2 watt and include wire wound. LIST PRICE $9.00 per 100. OUR PRICE $2.00 per 100. Post and packing 35c extra.

The condensers are in most popular brands and include Polyester, Paper, Mica, Ceramic and Electrolytic in values up to 8mfd. LIST PRICE $11.00 per 100. OUR PRICE $2.00 per 100. Post and packing 65c.

The pots, are all current types and include switch pots, and dual concentric, tandem, tab pots. etc. LIST PRICE $12.00 per dozen. OUR PRICE $2.50 per dozen. Post and package 60c extra.

FREE With each lot of resistors, condensers or pots. we will supply one new valve. Type 6U7G, 1T4.

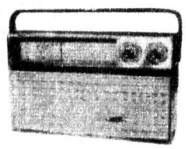
Regret special values in resistors, pots and condensers cannot be supplied.

LEADER SIGNAL GENERATOR LSG11

240V A.C. operated, 6 band 120KC to 390 Megs. Provision for crystal. **$39.50**
Post N.S.W., 75c; Interstate, $1.25.

NEW TRANSISTOR 8 KIT SET

SPECIAL PURCHASE ENABLES US TO OFFER THIS KIT SET AT $24.00



- Complete kit of parts with circuit and full instructions.
- Eight transistors.
- Magnavox 5X3 speaker gives excellent fidelity.
- High sensitivity, suitable for city or country use.
- Heavy duty battery for economical operation.
- Modern design, plastic cabinet with gold trim.
- Dial calibrated for all States.
- Available in colours of off-white, red, black.

DIMENSIONS 9" x 5" x 3" deep

Post N.S.W., $1.25; Interstate, $1.75.

A TRANSISTOR PREAMP FOR MAGNETIC PICK-UP OR TAPE HEAD

Using 3 transistors per channel as featured in Electronics Aust. Complete kit of parts including transistors. P.C. board and resistors and condensers. Circuit and full details supplied.

Stereo Kit **$8.50.**
Mono Kit **$4.50.**
240V Power Supply **$4.50.**

State if required for Pick-up or Tape Head.

NEW HIGH STABILITY CARBON RESISTORS 1 p.c. and 2 p.c. TOLERANCE

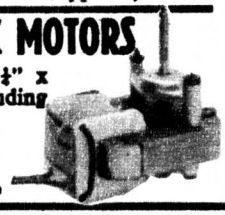
These imported resistors are in ½ and ¼ watt with values from 50ohm. to 1 meg. 1% and 2%. In packets of 50 mixed values.

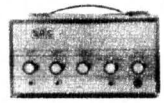
LIST PRICE 20c each.
OUR PRICE $2.00 per packet of 50.
Post and packing, 20c extra.
(Regret special values cannot be supplied.)

NEW 240V ELECTRIC MOTORS

3300 R.P.M. Size 3¼" x 2¼" x 3½", including spindle.

$2.75
plus 60c postage





NEW 25 WATT P. A. AMPLIFIERS

These amplifiers are suitable for installation in clubs, schools, restaurants, factories, etc. Wherever the amplification of speech or music is required.

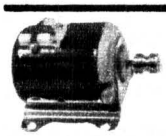
$63
Freight extra

SPECIFICATIONS

- Output impedance Line output (100, 166, 250, 500 ohms) Nominal power 25 watts.
- Inputs two microphone and pick-up radio with separate controls and mixing facilities.
- Tone control.
- Frequency response 30 to 18,000 CPS.
- Output impedance Line output (100, 166, 250, 500 ohms) or can be supplied with V.C. output (2, 3, 7, 8, 15 ohms).
- Dimensions 11in x 6in x 8in. Weight 25W 23lb. Freight extra.

NEW COLUMN SPEAKERS

Suitable for above Amplifier in walnut finished cabinet containing four 8" Rola Speakers Imp. 8 ohms. **$30.** (Freight extra.)



NEW MINIATURE MOTORS

Ideal for models, toys, etc. 1½ to 3 volts. 6,000 r.p.m. 39c each or $3.50 per doz. Post 10c.

Post 20c extra.

ROTARY SWITCHES

Single Bank 11 x 1, 4 x 2, 3 x 3	69c.
Single Bank 2 x 1,	35c.
Two Bank 3 x 3	$1.20.
Rocket Switches D.P.D.T.	55c
Rocket Switches S.P.D.T.,	45c

NEW IMPORTED SLOT CAR KITS AT LESS THAN HALF PRICE

Complete kit of parts including 12V motor and full instructions.

$1.90 post 25c

NEW EXTENSION SPEAKER

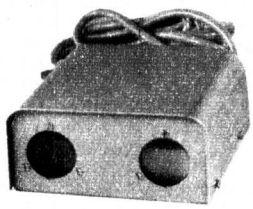
FITTED IN ATTRACTIVE LAMPBASE

FOR TRANSISTOR SETS
SUPPLIED WITH LEAD and PLUGS TO SUIT MOST SETS
(Shade not supplied).

$3.00
Post and packing 50c.

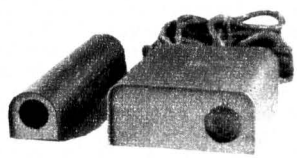
New Photo-Electric Burglar & Door Alarms at less than half price

DOOR ALARMS



240V A.C. operation
$12.00
Post & Packing $1.25 extra.
Buzzer $1.25 extra.

BURGLAR ALARMS



240V A.C. operation
$16.00
Post & Packing $1.50 extra.
Buzzer $1.25 extra.

NATIONAL RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, N.S.W. PHONE 56-7398

ANSWERS – continued

have to be in photostat form at 20c per page, a total of five pages for $1. In addition, this project used a commercial coil bracket (as did so many of our designs of that era) which is no longer readily available. Assuming that you already have a broadcast-band receiver, the most satisfactory approach may be to use a SW converter. Our latest design was a "3-Band Converter" published in May, 1966. (File No. 2/CV/20). An older design, but featuring an RF stage was the "Two Band Short-Wave Converter" of July, 1955. (File No. 2/CV/10) Complete articles of the latter two projects are available through the Information Service.

AMATEUR EQUIPMENT. I am a regular reader of "Electronics Australia" and find it an excellent publication, catering for a wide variety of interests. I intend building the solid-state communications receiver featured in recent articles, but I should like to adapt it for amateur use. Do you intend publishing a front end suitable for amateur bands, with provision for converter input? I feel this set-up would appeal to many amateurs whereas the receiver in its present form is a general communications receiver. Do you have plans for a transistorised converter for two metres and six metres? I have details of the converters published about five years ago, but was wondering if you planned a modern type. Also, do you have plans to describe medium to high power two-metre transmitter? **(B.L., Wollongong, N.S.W.)**

● Thank you for your various suggestions, which we shall keep on file for consideration as possible future projects. Presumably you will by now have seen the 144MHz solid state converter published in the April issue. At present we have no plans for the other projects which interest you, but we may be able to oblige at some future date.

WE'D LIKE TO HELP, BUT . . . I would be obliged if you would recommend a stereo setup for the playing of high quality classical music. Recently I came into possession of your publication and am rather baffled by the wide range of "High-Fi" equipment available. I realise the quality-price factor has a bearing on the selection and wish to be assured that my purchase will possess many years of maintenance-free service. Your advice would be much appreciated. **(J.M., Cabramatta, N.S.W.)**

● The heading for this particular letter was deliberately chosen. Did you read the Editorial in the April issue, J.M.? In this we tried to point out the difficulty, in fact the impossibility, of our recommending various types of equipment to individual readers.

NOVICE LICENCES AGAIN: After reading the letter from D.S. in your April issue, I too feel that novice licences should be granted to prospective amateurs, radio clubs and the like. I have also had to give up studying for the A.O.C.P., being in my fourth year of High school. There would be, as D.S. says, fewer illegal transmitters and also more revenue for the P.M.G. in the form of licence fees. Surely hams on the air could support us in our objectives to gain novice licences for the responsible hobbyists. **(C.H., Crafers, S.A.)**

● Letters like yours are keeping the subject alive but the fact that a novice licence scheme has thus far not been implemented here indicates that there is a body of opinion against it as well as for it. The difficulty of pursuing a career and a hobby at the one time is obvious but there is good reason to insist that all would-be amateurs satisfy some technical requirements. The freedom of the amateur to use bands instead of channels, and home-made rather than commercial-type approved equipment rests on the assumption that he is personally able to cope with the technical problems of setting up equipment. A couple of other points: There is provision right now for youth radio clubs to have a licence; secondly, the $2 fee is a trifling amount considering the cost of administering a licence.

Class of amplifier

What is meant by Class A, B and C amplification? I would like an answer in some detail as it has had me bothered for a long time. **(G.A., Strathfield, N.S.W.)**

● An amplifier may fall into one or other of the above classes, or into an intermediate class, by reason of the specific function it is called upon to perform and the amount of bias applied to the input element. Broadly speaking, voltage amplifiers operate under class A conditions, audio power amplifiers very frequently under class B (or AB which is midway between class A and class B), and RF power amplifiers under class B or class C.

In fairly general terms we may say that a class A amplifier is one in which the output waveform is the same as that applied to the input. The DC output current remains substantially constant over the full 360 degrees of the input cycle and no power is normally consumed in the input circuit. The bias value and signal level are so chosen that the amplifier functions over a limited, linear section of its input/output curve.

A class B amplifier has a higher value of bias than class A and the signal level is such that, during the input cycle, the amplifier may actually be cut off completely for up to half the cycle. In audio service, this would result in a very distorted output were it not for the fact that class B audio amplifiers are always operated in a push-pull configuration whereby the "missing" section of the output waveform is supplied by the other amplifier. Because of the relatively high input signal level, class B amplifiers normally consume power in the input circuit.

If the operating bias is adjusted so that the output current flows during something between 360 degrees (class A) and 180 degrees (class B) of the input cycle, the amplifier is said to be in class AB. If the signal level is small so that the input circuit does not consume power, a "1" subscript is added, viz, AB1. If power is consumed under normal conditions, a "2" subscript is added. Power output under class AB conditions is somewhat less than that obtainable under a class B rating.

In an RF power amplifier, distortion of the waveform is normally offset by the oscillatory action of the tuned output circuit. The bias is adjusted so that, under no drive conditions, the amplifier is completely cut off. High levels of input signal drive the stage into conduction, usually to the point of relatively large amounts of input power being consumed. High peak output is possible under these conditions, although the output current may flow for considerably less than 180 degrees of the input cycle. If it is important to minimise waveform distortion as, for example, in an SSB amplifier, class B operation is selected.

An examination of a basic text on valve fundamentals will make the picture clearer, perhaps with the aid of diagrams.

SOUND PROJECTORS

Cinevox Prefect and Harmour and Heath 16mm in good working order. 240v operated, complete with speaker and amplifier.

from $90.00

CIRCULAR SLIDE RULE

3¾in diameter. Will do the same work as the conventional slide rule. Instruction book included.

$1.25 each
Post 10 cents.

P.M.G. TYPE TELEPHONES

Standard desk type with magneto bell calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected together on single line.

$23.00
(2 TELEPHONE SETS)

30c cartage to rail. Freight payable at nearest attended railway station.

Please note we are now able to include ½ mile of telephone cable FREE with each set of Phones.

BATTERY CHARGERS

240 volt A.C. Input.
Each battery Charger will charge either 6 or 12 volt batteries.
2 amp. without meter, **$13.75**
2 amp. with meter, **$15.75**
Post N.S.W. 70c; Interstate 95c.

MINIATURE ELECTRIC MOTORS

1½ to 3 volts D.C. Ideal for model boats, cars, planes, etc. Strong torque. Only
65 cents each or 10 for $4.00.
(Post 7c).

TRANSCEIVER

(2-way radio) R.C.A. America RT 68, 24 volt, operated 10 watt output 38-54 megacycles F.M. crystal locked. Transmitter and receiver using frequency synthesiser in 100 K/cs: step 10 channel per meg/cycle with power supply. Leads, mike and headphones $45, 60c cartage to rail. Freight payable at nearest attended railway station.

TRANSCEIVER

(2-way radio) 62 set ideal small ships, Hams, etc. 1.6 to 10 megs. Crystal locked or V.F.O. controlled 5 watt output. Complete with antenna, headphones and mike $60. 60c cartage to rail. Freight payable at nearest attended Railway Station.

HEAD PHONES

Low impedance moving coil fitted with rubber muffler to reduce external noise, fitted with press to talk, dynamic hand microphones. Ideal for use with all types of transceivers. $3.50 pair. Same with black felt muffler, $4.50 pair.
Post N.S.W 25c; Interstate 30c.

COLLINS TRANSCEIVERS

Auto-tuned 100-150 megacycles, 10 channels .. ..

$65.00

6 TRANSISTOR radios, new, in leather case, only $12.50 each, post N.S.W. 60c. Interstate 85c.

AVO MULTI METER

Type CT 38
$75.00

A.W.A. AUSTRALPHONE

Transceivers 12 V
New Complete Station.
1.6 to 10 megs on transmit.
0.54 to 16 megs on receive.
$150.00

LAVOIE HETERODYNE FREQUENCY METERS

10-100 Megs. LA5. **$250.00.**

100-500 M/cs. **$350.00.**

ADLER FREQUENCY METER

100Kc-20 M/cs. **$175.00.**

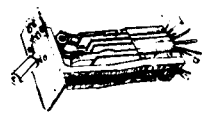
P.M.G. Phone Jack and plugs, 25c each, 45c the pair.
Post 7c.

NIFE CELLS

1.2 Volt fully charged, 4in x 3in x 1in 4 AH.
$1.00 each
Post, N.S.W., 25c; Interstate 35c.

WALKIE TALKIE TWO-WAY RADIOS

P.M.G Approved Citizen Band. 9 Transistor, **$79.00 per set of 2.** Post, N.S.W. 50c; Interstate, 60c.



P.M.G. TYPE KEY SWITCHES. 45c each. Post, 15c.

BC 221

Frequency Metres
$55.00

VALVES

BRAND NEW

IN CARTONS

Special discount for quantity

807	75c	CV850	$1.50
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3FP7	$2.95	5BP1	$3.50
3JP1	$2.95		
V1669 4/1	$2.95	CY2184	$2.95

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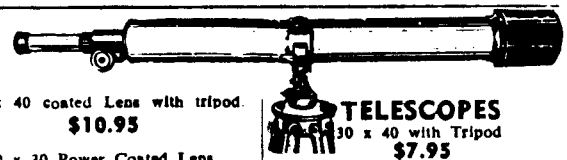

45 x 40 coated Lens with tripod.
$10.95

30 x 30 Power Coated Lens Brand new.
$3.75

60 magnification with a 60mm coated objective lens. With tripod.
$23.00

As illustrated.
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TELESCOPES

30 x 40 with Tripod
$7.95
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PETROL MOTOR GENERATOR SET

BRAND NEW EX-ARMY

300 watt, 15 volts, 20 amps. Made in Canada. Complete w.th tools, instruction book, spares, etc. Only **$75.00**

$1 cartage to rail, freight payable at nearest attended railway station.

HIGH STABILITY RESISTORS

I.R.C. brand new, usually 80c ea. 50 assorted values for only
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Post 15c.

STEREO headphones, brand new, $7.50. post N.S.W. 60c. Interstate 85c.

TYPE S POWER SUPPLY

(240 Vac supply for AT 5-ARB) suit most types of Disposal transmitters and receivers outputs 250 volt, 10ma 550 volt 200ma, 300 volt 100ma, **$30.00**

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21 gauge copper, plastic covered. Ideal telephone or bell wire. 1,320ft coil of twin (equal ½ mile) **$7** per coil.
Post. N.S.W. 70c; Interstate $1.20.

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Gramo Motors. New. Made in U.S.A. 4-speed 240 volt A.C. 50 cyc. Only **$2.75** each.
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CO-AXIAL SWITCH

70 ohms 4 positions.
can be motor driven completely waterproof 70 ohms type connectors. Housed in metal case 9in x 8in x 8in $5.00 each. Post N.S.W 70c. Interstate $1.20.

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SELSYN MOTORS MAGSLIP Mk. II .. .. **$5.25 ea.**
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Sold as is without power supply, leads, accessories, etc. Only $15.
Or complete with above gear, $35.

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PRISMATIC. Coated Lenses
Brand new. Complete with case.

8 x 30	**$18.75**
7 x 50	**$22.15**
10 x 50	**$23.07**
12 x 5	**$23.95**
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3000 TYPE RELAYS

P.M.G. 200 Ohm — 1,500 Ohm Coils, **$1.25** each.

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240 VAC with pick up Terminal. Used in good order Ex Studio.
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SPECIAL lucky dip valve offer, 15 new valves in cartons for only **$2.00.** We haven't got time to sort them, so you reap the benefit.
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MINE DETECTORS

Ex A.M.F with Instruction Book. Complete in wooden case. Ideal for plumbers, councils for locating buried pipes, etc. Freight payable at nearest attended railway station. **$39.00**

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50-volt D.C., suit slot car. Lap counters, etc.
$1.25 each. Post 13c.

ALTEC STUDIO MICROPHONES

639B Western Electric, top grade, original cost **$250,** ideal Broadcast Studio, music recording, Church and play recording, etc.
Fraction of original cost.
Price on Application.

240 VOLT 522 POWER SUPPLY

Supplies all necessary voltages to operate 522 transceiver from 240 V A.C. Complete and ready to plug in **$30.00.**

SOLENOIDS

Plunger Type 12V 300M.A. Suit electric camera control, miniature trains, radio, etc.
$1.25. Post, 10c.
200 Mill. amp., 24 volt, 1/8in push movement.
$1.25. Post 10c.

CONDENSER LENS

2½in DIAM. 2in FL. **$1.50** each or **$2.50** per pair. Post 21c.

CONDENSER LENS

1½in diam. 1½FL. **50c** each.
Postage, 17c.

FOUR CHANNEL BRANCHING AMPLIFIER

With 4in Vu, meter GLORAD. Complete with Portable Power Converter. 600 ohm balanced input and output. Ideal for outside broadcasting, etc.
$39.50

TEN CHANNELS VHF TRANSCEIVER

Types TR1934 100-125 meg/cys. and TR1935 125-150 meg/cycles. 28 volt DC operated AM single crystal locks both TX and RX on same channel complete with generator.
$33.00

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TOP QUALITY BRAND NEW

		POST
3" x 150' ..	65c ..	9c
3" x 600' ..	$1.35 ..	13c
5" x 900' ..	$1.78 ..	13c
5" x 1800' ..	$3.29 ..	13c
7" x 1200' ..	$2.75 ..	21c
7" x 2400' ..	$4.45 ..	46c
7" x 3600' ..	$6.00 ..	46c

CASSETTE TAPES

C60 **$1.60.** C90 **$2.20.** C120 **$2.99.**
Post 13c.

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Rack Mounting Tape Recorder, ex A.B.C. 7½-15 I.P.S. Full track tested. **$150.00.**

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Marconi Video Oscillator type TF885A 0-12 M/cs. **$75.00.**

Marconi H.F. Sig. Gen. 85 K/cs. to 25 M/cs. **$65.00.**

Pye 4 Channel Crystal Locked Oscillator. 1.5-30 M/cs. New.
$25.00.

TRANSPONDER APX6

with Lighthouse Tubes. Can be converted to 1200 M/cs. **$17.00.**

WHEATSTONE BRIDGE

Top grade
In Multiples up to 1000
$65.00

Deitch Bros.

70 OXFORD STREET, SYDNEY, 2010

SORRY, NO C.O.D.

ANSWERS – continued

RADIATION: I have been reading your magazine for a few years now, and enjoy doing so very much. I have built a couple of your circuits with a lot of success. What I would like to know is if you have, or will be presenting a circuit for a radiation detector which will tell the amount of radiation in the atmosphere. **(M.B., Turramurra, N.S.W.)**

● Unfortunately, M.B., there seems to be little demand for an instrument of this type. In any case, we feel that such an instrument, if it were to be usefully accurate, would be very expensive. The nearest we can come to such an instrument would be an ordinary geiger counter. Our last counter was described in July, 1962 (File No. 3/GC/2). It may be obtained through the information service for the usual 20c fee.

CRAMPED DIAL: I was recently given a small 8-transistor radio with which I am able to receive short-wave. I am able to receive between 25 and 90 metres but this is jammed into a dial of two and a half inches, making accurate tuning very hard. Is there a way of obtaining greater accuracy? Also I get a lot of interference. Is there a way of removing this? **(R.D., Seven Hills, N.S.W.)**

● Bandspread is usually achieved in one of two ways: by mechanically changing the tuning mechanism to provide a longer travel between the ends of the dial; or electrically, by allowing a smaller "bite" to be taken of the band in any one stage of tuning. Unfortunately, both these processes are very hard to arrange in a commercial receiver and we do not recommend your trying it. You did not state the type of interference you encounter. It may be picked up by the aerial, in which case a better type of aerial is needed, or it may be electro-magnetic interference from some type of electrical appliance. (Motors, fluorescent lights, etc.) In this case it may be possible to have suppressors fitted to the appliance. If you wish to follow this up, we suggest you refer to our article, "Beating the Noise Problem" (Jan., 1968, File No. 2/AE/21). For more elementary conditions, readers may be interested in the article "Combating Interference With A Wavetrap" (May, 1969, File No. 2/AE/22). ■

THE SERVICEMAN

(Cont. from Page 100)

the old lead restored and a new one added. Thus adaptor was piled on adaptor until each G.P.O. sprouted a festoon of cables and fittings suggestive of some science-fiction growth from outer space.

Nor was a great deal of care taken to protect the cables. Most trailed across boggy ground, to be trodden into the mud, while some ran along the bottom of a drainage trench under several inches of water.

All of which amounted to a situation somewhat less than ideal in terms of safety. Ordinary rubber or plastic-covered flex is reasonably tough, I suppose, but it was certainly never intended to take this kind of punishment. It would seem to be inevitable that, sooner or later, one of them would suffer severe physical damage and create a serious hazard as a result.

As for the double adaptors, these have a number of disadvantages. Quite apart from the tendency which a stack of them have to be unstable, and thus not particularly reliable, there is the disturbing fact that many designs produce a natural inversion of the active and neutral pins at one outlet. And, even if these devices do not have the approval of the supply authorities, there are plenty of them around. In a situation like the one just described, where one either uses a double adaptor or goes without power, most of us would yield to temptation and use the adaptor. The answer would seem to be obvious: A legal obligation to provide adequate G.P.O.s for the number of vans to be accommodated. ■

Particle Detectors

Continued from Page 91)

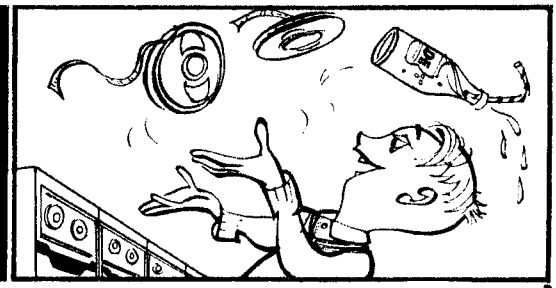
a proton when struck by a neutron. As the proton is charged, this may be readily detected.

Electronic circuits used with the ionisation tubes and scintillation detectors enable the investigator to determine not only the total number of particles, but also to classify the particles by their energies.

Displays are arranged in a variety of forms. The best known is the audible signals given from a standard geiger counter, where the pulses are simply amplified and heard as clicks on a loudspeaker or set of headphones. More elaborate instruments contain an integrating circuit and a meter to give a visual rate reading, and even more complex systems employ a digital counter and timer.

Some scintillation counters consist of an array of digital counters and timing mechanisms. Each display is used to indicate the numbers of particles in different energy ranges. The results may also be simultaneously displayed in the form of a graph on a cathode ray tube. ■

ALBERT AND THE COMPUTER



You've 'eard of young Albert Ramsbottom's
Adventures at 'ome, and at zoo;
Alas for the rest of the people,
He'd other adventures, a few!

One day, teacher said in the classroom,
"Computers . . . thou knows nought, I knows;
"So let's go to place where they 'ave one,
"An' see 'ow the ruddy thing goes!"

Next day, when they got to computer
Man talked about numbers an' sooch,
Then said "Keep thy digits in pocket . . .
"See all that yer can — but don't touch!"

On Albert, instructions were wasted;
Place bristled with things to explore.
And not to be daunted by teacher,
'e stayed out of sight, near a door!

Unseen, 'e sneaked oop to the console
An' pooshed all the buttons like mad,
'e wiggled the knobs and the switches,
Not knowin' results would be sad.

Conductor explained about programs,
An' pointed to tapes in a rack;
'e didn't see Albert remove 'em
An' mix 'em, when pootting 'em back!

Conductor raised door in the floorin'
And showed 'em some cables in slot,
Alas, Albert tripped on the carpet,
And poured lemonade on the lot!

They saw foony thing like typewriter,
Which printed out numbers on reels,
But one of the kids kicked young Albert,
Who spat chewin' gum in the wheels!
But nobody 'appened to notice
The things that occurred on the way,
In fact, everyone went 'ome 'appy,
Unaware what would follow next day.

First off, the instructions to fact'ry
Showed oop urgent need for more spares.
Said foreman: "By time we've met orders,
Our 'eads will be full of grey 'airs!"

'E said to the staff: "Now get crackin. . .
"We'll pay dooble time, plus yer tax;
"Forget yer days off an' yer Soondays,
"Till we've filled all the space in the racks!"

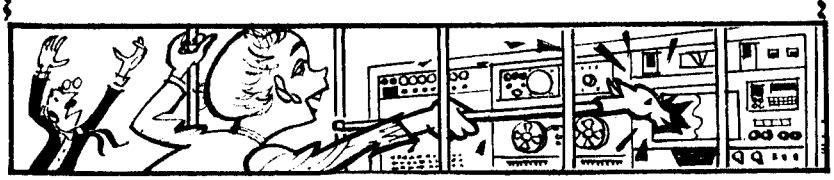
In office the clerks were delighted
To find that they'd all got a raise,
But cleaners, it seemed, were demoted,
So they went on strike for three days!

Accountants next ran off some figures,
To send down to stock exchange scene;
You should have seen looks of amazement,
When noombers appeared on the screen!

Investors said coompany was boosted,
And sold all their stock for a song;
In fact, stock exchange were in chaos,
Till they found that the figures were wrong!

They printed the tale in the paper,
Said: "someone's been playin' the fool."
His Dad said: "Yon sounds like young Albert,
"I'm glad 'e were safely at school!"

They've put a big cage round computer
An' locks on the doors, every one.
Yer'd need stick with an 'orses 'ead 'andle.
Before yer could 'ave any fun!



RF PREAMPLIFIERS

(cont. from page 87)

but a small supply can be built up to operate from a source of say 6.3 volts AC. This supply may be obtained from the heater supply of the receiver proper where convenient. On the other hand, a small heater transformer rated at 6.3 volts and up to one amp would be suitable. A circuit of the suggested power supply is shown in a separate diagram.

Testing of either unit in quite simple. The usual wiring check should be made before applying power. The output of the amplifier is fed into the aerial terminal of the receiver, preferably via a short length of coaxial cable. A suitable aerial is connected to the amplifier input.

Select the appropriate range (in the case of the switched unit) to suit the frequency to be tuned on the receiver. Tune the wanted station on the receiver and then peak the signal by tuning the RF Amplifier. As a preliminary check, this procedure should be carried out across the full coverage of the system. More than likely, signals will not be available over such a wide range at any given time. If a signal generator is available, it could be used to advantage.

The RF Amplifier is now complete and the method of using will be clear by now. At the same time, a little experience will soon show the best way to use this device. In some cases, it will be possible to tune the RF Amplifier to the "image" signal, rather than the wanted one. This must be carefully guarded against, where this condition exists.

Such a condition can occur, in single conversion receivers using an intermediate frequency of 455KHz (or lower) and at signal frequencies from about 7MHz, getting progressively worse as the frequency is increased. In the case of a 455KHz IF, with the local oscillator tuned to the high side of the wanted signal, another signal at twice the IF, or 910KHz higher, will also get through the system and cause interference. However, with the RF Amplifier, extra RF selectivity is achieved and the image frequency will be either eliminated, or reduced in severity. ■

Frame Antenna for DX

(cont. from page 102)

To ensure that weak stations close to strong ones are not overlooked when tuning across the MW band, tune very slowly and listen for signs of weaker signals through the sidebands of the stronger ones.

Slow cyclic fading is nearly always present with medium-wave DX signals. Fast fading, which is often counted in fades per minute on the SW bands, is seldom encountered on the medium waves. If two stations are heard simultaneously on a frequency, their relative signal strengths will change continually. Under certain conditions, each station may be heard clearly for a short time during a fade of the other.

As the best medium wave DX signals are heard during periods of low solar activity (as exists at the moment), several years of improving conditions lie ahead. ■

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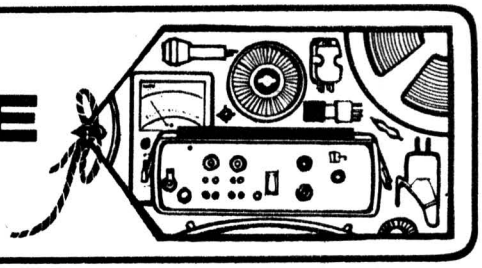

FOR SALE

UNIJUNCTION transistors. Texas TIS43A similar to 2N2160, 2N2646. Data sheets and circuits with each device. $1.00 ea.. 1/4 Seaview St., Waverley, N.S.W.

MODEL railways. Call or write for free literature on this fascinating hobby. Ready to run or build it yourself kits. HO and N. Rivarossi; Peco; Triang Hornsby; Atlas, etc., P.J.P. Productions. 15 Hamilton Street, Gisborne, Victoria, 3437.

BACK issues Electronics Australia stocked 50c ea.., prompt service post free. T. Weir, 56 O'Connor St, Haberfield, N.S.W., 2045. Phone 798 7569. Wanted to buy copies also.

MAIL orders: IC, transistors, FET, diodes, zener diodes, electronic parts, kits, tapes, meters, etc. Cheapest prices. Free catalogue on request. IEC, P.O. Box K12829, Hong Kong.

CAPACITOR discharge ignition systems $32.000. 12V systems only, state model of car, and whether positive or negative side of battery connected to the car body. Two Way Radio Service, 31 Rotherham Street, Kangaroo Point, Brisbane, Queensland.

BURGLAR ALARMS, 12V, 15uA. Transistor control units $12, plus 12 p.c. s.t. Unit on 4 x 2 plate and case, $16, plus s.t. 4½V rotary siren, $10.50. All above plus 60c p. and post. Foil tape terminals, mats, key switches, bells, reed switches, infra-red ray unit. Complete quote and installations service to insurance requirements.
EDORE ENTERPRISES,
802 Doncaster Rd, Doncaster, Vic. 848 1386.

LABCRAFT 605L turntable, all-balance arm, Decca "Dream" ceramic cartridge, good condition, $60. Hodgson, 3 Brodie Street, Toowoomba, Qld., 4350.

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1C TAA300, class B AF amp., 9V rail 8mV at 15K in, 1W RMS to 8-15 ohm load. $2.65 inc. data, cct, post. Pedalfer Associates. 24 Gulfview Rd, Blackwood, 5051.

MODEL marine and stationary engines. Boilers, for students. Bolton, 72 King Street, Sydney. Illustrated catalogue $1.50.

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BARGAINS BC108, 45c, BC109, 50c, BC107, 55c, BF115, 55c, 2N5459/MPF105, $1.00, AD161/162, $2.70, 187/188, $1.70, 127/128 $1.40, 263055, $1.60, matched pair, $3.40 2N3053, $1.20, OC44, 45, 71, 72, 40c, OC171, 55c. Diodes OA91 type, 17c, OA202, 20c, 1N4004 (1A 400V.) 35c, 1N4006 (1A 800V, 50c, 6A 400V, 70c. SCR 15A 100V, stud mounting, suit power supply protection, $2.50 also 15A 400V, $3.50. 1 watt zeners, 9 or 12 volt, $1.00. Pots ganged small size, long shaft, 470K plus 470K, log or lin, 47K plus 47K log only, $1.40, single 47K lin., 470K lin, 40c. Post 10c. All goods guaranteed new and as advertised. No substitutes. Return mail service. T. & M. Electronics, Box 57, P.O. Haberfield, N.S.W., 2045.

TIME switches $10 plus 50c p.p., 175 Majors Bay Rd., Concord, N.S.W. 73 3018.

BACK copies Electronics, 148, 1956-68. Reas. offer. S.A. 37 4908

STROBE lights. Stops motion. Disco effect $45. ST141 $1. 2N2916 green 80c. AM or FM miniature transmitting transistor equipment. Winding wire, most sizes, cheap. S.A.E. for details o above. J. Sullivan, Box 16, Drayton North, Toowoomba, Qld.

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TRANSFORMERS wound. Output or mains and specials to order. Reply with S.A.E., Paris Radio Electronics, 7a Burton St, Darlinghurst, N.S.W. Phone: Sydney 31 3273.

TAPE to disc service. Take advantage of W. and G. Records' professional experience, when next needing a tape to disc service. W. and G. Record Processing Co., 185 A'Beckett Street, Melbourne. Tel.: 329 7255.

TOP Quality discs from your tapes. Any quantity, all sizes and speeds. We guarantee our work to comply with R.I.A.A. and A.B.C.B. standards. Inquiries welcome. Write for details, A.A.V.R., 87a Mullens St., Balmain, 2041. Phone 82 5158, Sydney.

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AUSTRALIAN Tape Recordists Assoc. Tapespond with members everywhere. Manual of tape recording available to non-members, $1. Box 970H, G.P.O., Adelaide, 5001.

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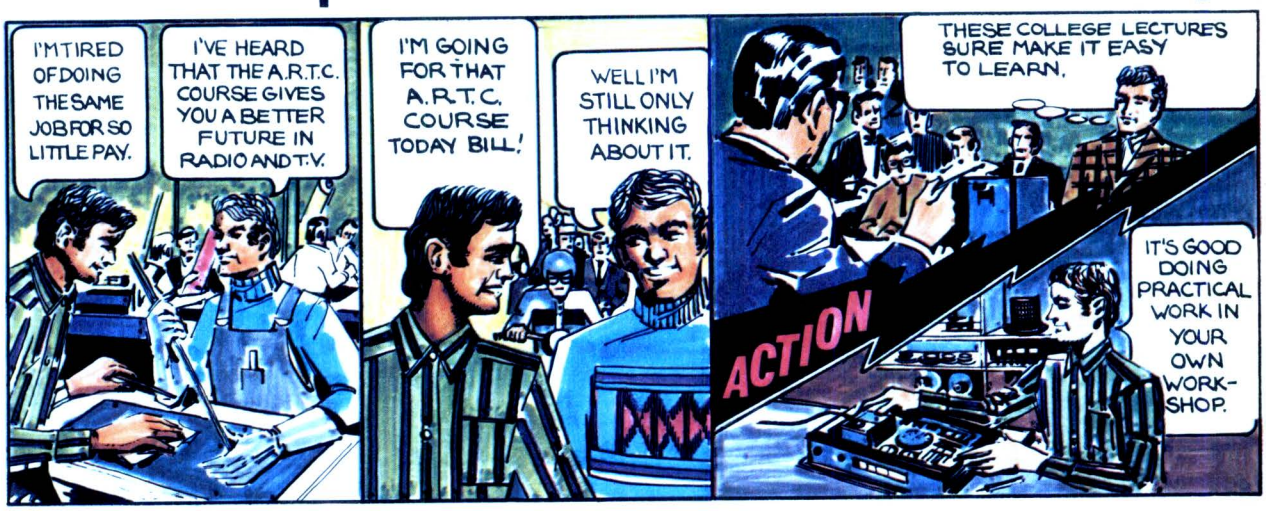

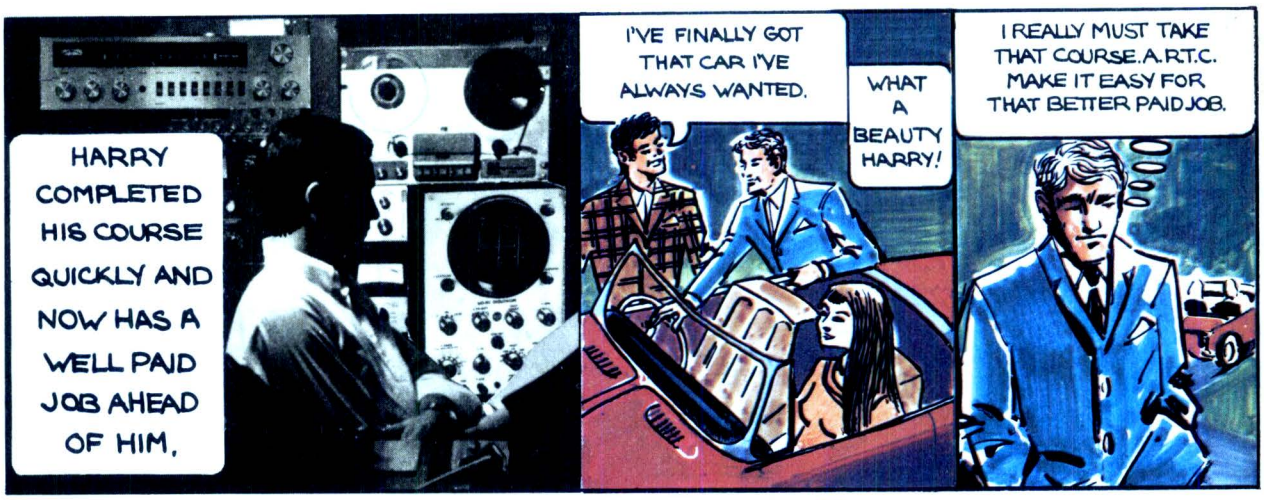

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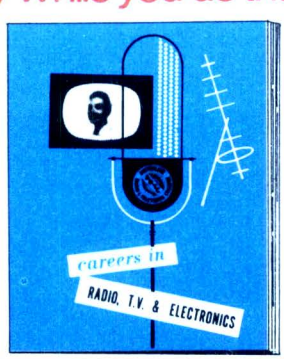

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